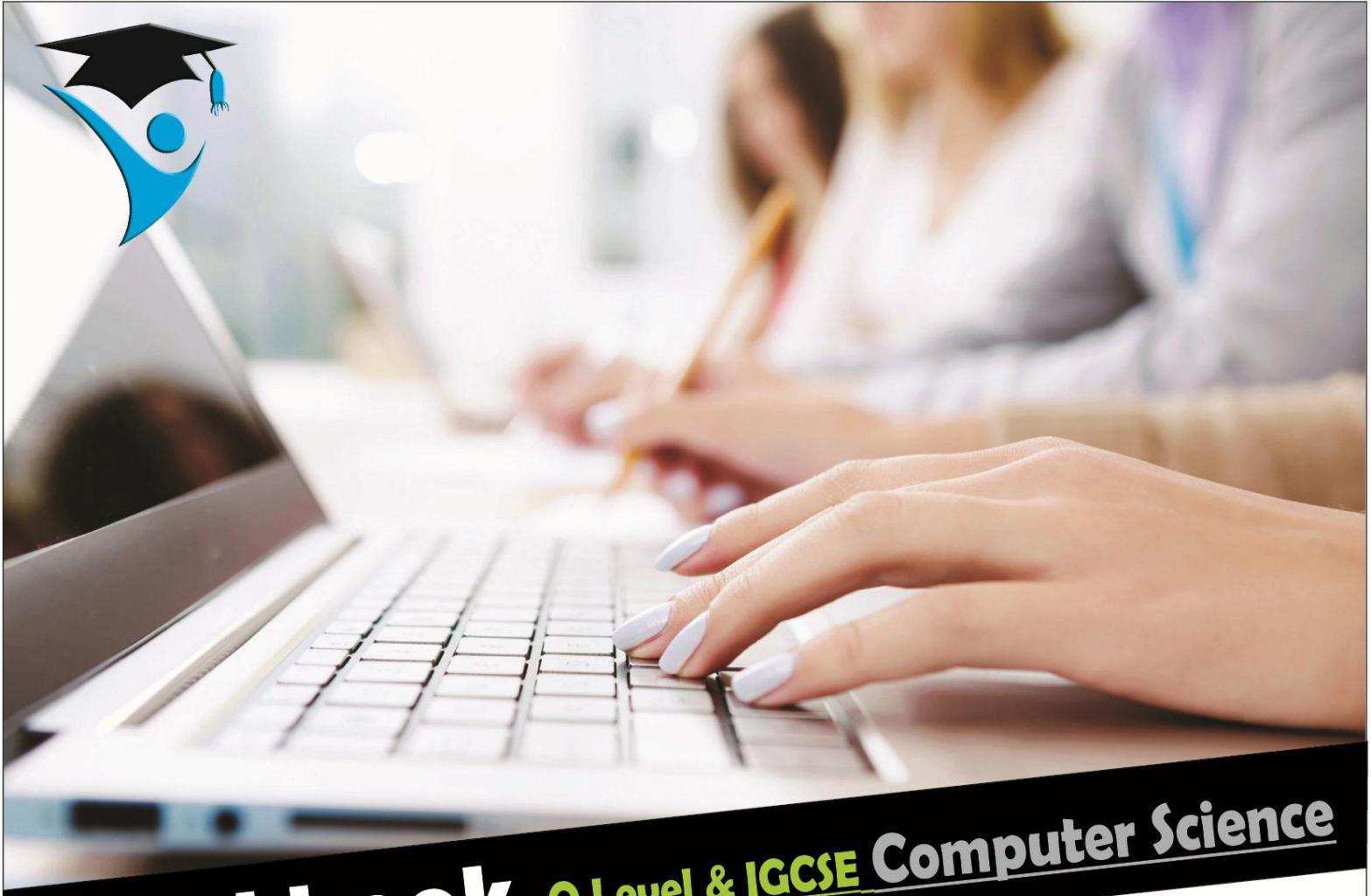


Workbook O Level & IGCSE Computer Science

P1 Theory of Computer Science

Inqilab Ruknuddin Patel

Topical Past Paper Questions

Lecture Notes

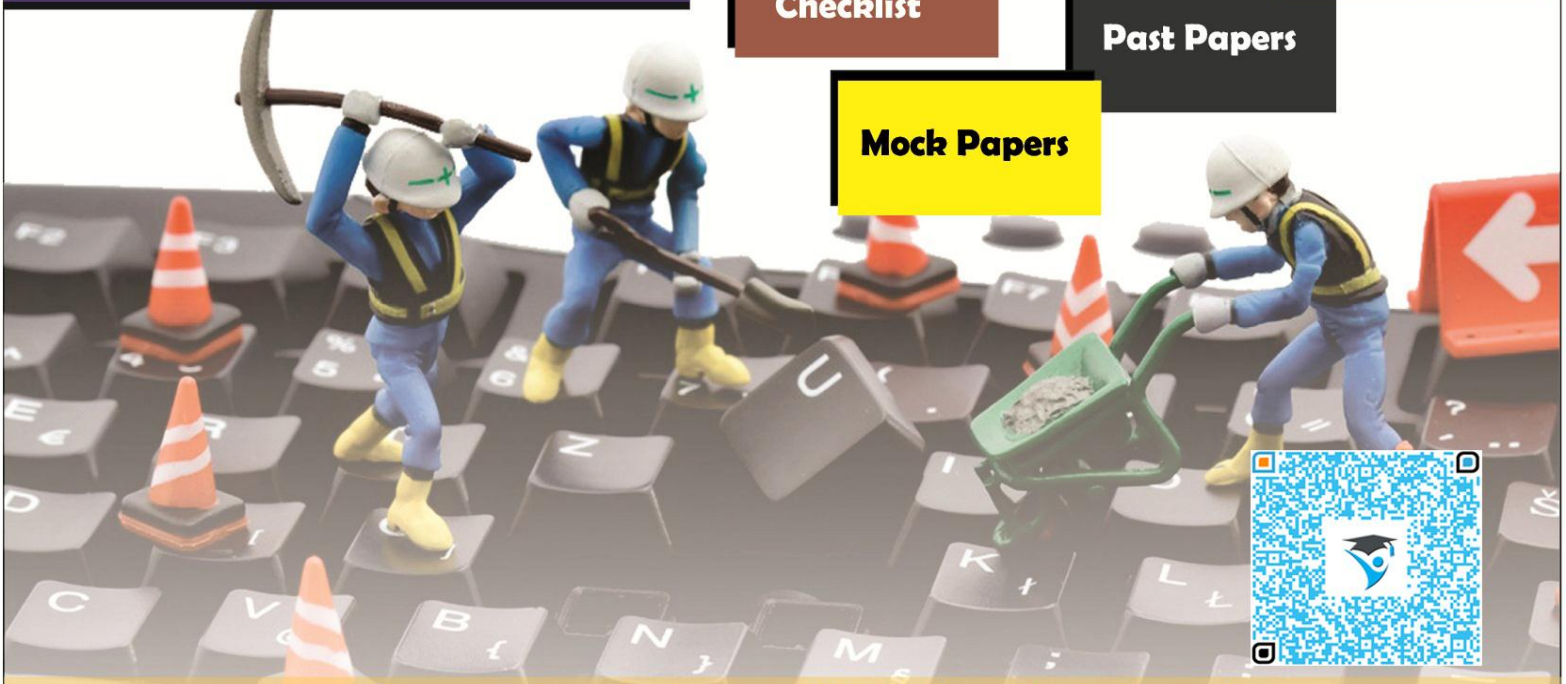
Practice Questions

Revision Guide

Revision Checklist

Past Papers

Mock Papers



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Contents

Syllabus content & assessment at a glance 4

1.1 Data representation 7

Denary (Decimal) Number System:- 7

1.1.1 Binary Number System:- 8

1.1.2 Hexadecimal Number System:- 11

Examination Questions 20

1.1.3 Data storage 26

Examination Questions: 32

Error Detection and Correction 33

Examination Questions: 36

Marking Schemes 55

1.2 Communication and Internet technologies 57

1.2.1 Data Transmission 59

Advantages and disadvantages 63

Examination Questions 66

1.2.3 Internet principles of operation 70

Examination Questions 82

1.3 Hardware and software 87

1.3.1 Logic Gates 87

Examination Questions 92

1.3.2 Computer architecture and the fetch-execute cycle 105

Examination Questions 111

1.3.3 & 1.3.4 Input & Output Devices 117

Examination Questions 137

1.3.5 Memory, storage devices and media 152

Examination Questions 161

Marking Scheme 181

1.3.6 Operating systems 185

Examination Questions 188

PATEL

Computer Science with Inqilab Patel

1.3.7 High- and low-level languages and their translators 191

1.4, 1.5, 1.2.2 Security aspects Security &Computer Ethics 194

Examination Questions 195

Examination Questions 206

Summer 2015 P11 227

Marking scheme 235

Summer 2015 P12 239

Marking Scheme 247

Winter 2015 P12 251

Marking Scheme Winter P12 259

Winter 2015 P13 262

Marking Scheme p13 Winter 2015 268

Winter 2015 0478 P11 270

Marking Scheme 275

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Syllabus content & assessment at a glance

Sections	Topics
Section 1	**Theory of Computer Science** 1.1 Data representation 1.1.1 Binary systems 1.1.2 Hexadecimal 1.1.3 Data storage 1.2 Communication and Internet technologies 1.2.1 Data transmission 1.2.2 Security aspects 1.2.3 Internet principles of operation 1.3 Hardware and software 1.3.1 Logic gates 1.3.2Computer architecture and the fetch-execute cycle 1.3.3 Input devices 1.3.4 Output devices 1.3.5 Memory, storage devices and media 1.3.6 Operating systems 1.3.7High- and low-level languages and their translators 1.4 Security 1.5 Ethics
Section 2	**Practical Problem-solving and Programming** 2.1 Algorithm design and problem-solving 2.1.1 Problem-solving and design 2.1.2 Pseudocode and flowcharts 2.2 Programming 2.2.1 Programming concepts 2.2.2 Data structures; arrays 2.3 Databases

Assessment at a glance

Components	Weighting
Paper 1 Theory 1 hour 45 minutes This written paper contains short-answer and structured questions. All questions are compulsory. No calculators are permitted in this paper. 75 marks Externally assessed.	**60%**
Paper 2 Problem-solving and Programming 1 hour 45 minutes This written paper contains short-answer and structured questions. All questions are compulsory. 20 of the marks for this paper are from questions set on the pre-release material. 1 No calculators are permitted in this paper. 50 marks Externally assessed.	**40%**

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About the developer of this workbook

Inqilab Patel is an O &A Level Computer Teacher. He highly qualified and experienced full of devotion and dedication. He has taught in many schools including Yaqeen Model School, Karachi Cadet School, KN Academy, Beacon House and The City School, PAF Chapter. Cambridge has selected him as a Member of Cambridge Editorial Review Board to review different course material, being uploaded from different parts of the world.

His entire career path revolves around computer science; either he was a student or a teacher. He got a chance to polish his skills of teaching and studying more about computers at various levels which has given him great confidence in presenting himself for any senior level position of transferring his knowledge to the youth.

He has not stopped, he is continuing with his education at the higher levels. It is his second semester of M Phil computer studies from a well-know university of Pakistan; The Institute of Business & Technology.

Inqilab Patel knows a lot of methods of teaching computers and has developed tutorial notes, worksheets and assignments for my students. He also maintains a website (www.ruknuddin.com) which is specifically designed for the support of those who want to excel in GCSE computer science.

He also regularly contributes material to CIE teacher support website, for which he receives appreciation from different people across the world. He has also received various training in innovative and special methods of teaching this subject.

Paper 1

Theory of Computer Science

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1.1 Data representation

Candidates should be able to:
1.1.1 Binary systems
• recognise the use of binary numbers in computer systems
• convert denary numbers into binary and binary numbers into denary
• show understanding of the concept of a byte and how the byte is used to measure memory size
• use binary in computer registers for a given application (such as in robotics, digital instruments and counting systems)
1.1.2 Hexadecimal
• represent integers as hexadecimal numbers
• show understanding of the reasons for choosing hexadecimal to represent numbers
• convert positive hexadecimal integers to and from denary
• convert positive hexadecimal integers to and from binary
• represent numbers stored in registers and main memory as hexadecimal
• identify current uses of hexadecimal numbers in computing, such as defining colours in Hypertext Mark-up Language (HTML), Media Access Control (MAC) addresses, assembly languages and machine code, debugging
1.1.3 Data storage
• show understanding that sound (music), pictures, video, text and numbers are stored in different formats
• identify and describe methods of error detection and correction, such as parity checks, check digits, checksums and Automatic Repeat reQuests (ARQ)
• show understanding of the concept of Musical Instrument Digital Interface (MIDI) files, jpeg files, MP3 and MP4 files
• show understanding of the principles of data compression (lossless and lossy compression algorithms) applied to music/video, photos and text files

Number System:-

"The system of counting and calculating is called number system."

Number system is based on some characters called digits. The number of digits is known as base or radix of the number system. For example binary number system uses two characters 0 and 1 and its base is 2.

Computer uses following four numbers:

i) Denary (Decimal) number system
ii) Binary number system
iii) Hexadecimal number system

Denary (Decimal) Number System:-

"The number system which is based on 10 characters from 0 to 9 is called denary (decimal) system."

It is the most common number system. The digits of decimal system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. The value of each digit in a figure depends upon its weight. The weights are based on power of 10.

The weights of digits according to their positions are given below:

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Position	5th	4th	3rd	2nd	1st
Weight(Decimal Notation)	10^4=10000	10^3=1000	10^2=100	10^1=10	10^0=1

For example 76854 can be expressed as:

$76854 = 7 \times 10^4 + 6 \times 10^3 + 8 \times 10^2 + 5 \times 10^1 + 4 \times 10^0$

$= 7 \times 10000 + 6 \times 1000 + 8 \times 100 + 5 \times 10 + 4 \times 1$

$= 70000 + 6000 + 800 + 50 + 4$

$= 76854$

1.1.1 Binary Number System:-

"The number system which is based on 2 characters 0 and 1 is called binary system."

Computer circuitry represents data in a pattern of ON and OFF states of electric current. The state ON is represented by '1' and OFF is represented by '0'. Binary system is used for internal working of electronic computers.

The value of each digit in a figure depends upon its weight. The weights are based on power of 2.

Binary numbers are fundamental to the way that all modern computers work. They are used to represent any data stored within a computer system.

Using only 0 and 1 makes it easier to design the electronic circuits that the computers will use. This is because, if the computer wants to check a value in any part of the circuit, it only needs to detect whether or not there is any electricity. If there is electricity, the value is 1, if there is no electricity, the value is 0.

The weights of digits according to their positions are given below:

With the help of above chart we can derive a sequence of number, that sequence is known as Binary Notation. The binary notation is a sequence of numbers are based on power of two and arrange from right to left, as given below:

Position	5th	4th	3rd	2nd	1st
Weight	2^4=16	2^3=8	2^2=4	2^1=2	2^0=1

Position	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Binary Notation	2048	1024	512	256	128	64	32	16	8	4	2	1

Binary notation is ….512 256 128 64 32 16 8 4 2 1

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If a switch is on, it can represent the number 1. If it is off, it represents 0. These states can also be interpreted as TRUE or FALSE. If you have enough switches, you can store all sorts of data. You could ask a question such as 'will you give me some money?' and you can get an answer in binary digits:

0 = NO
1 = YES

This is making use of just 1 bit of data. Add another bit and you can say more:

00 = NO 10 = MAYBE
01 = NEXT WEEK 11 = YES

The more binary digits you have, the more information you can store and process. Most computers store bits of data in memory in groups of eight. Eight bits stored at one location is called a byte. Sometimes it is useful to work on just half a byte. Half a byte is called a nibble.

1	1	1	1	1	1	1	1
bit	bit	bit	bit	bit	bit	bit	bit
Nibble				Nibble			
Byte							

A bit (binary digit) is the basic unit of information in computing.

A nibble consists of 4 bits. A nibble corresponds to a single hexadecimal digit.

A byte consists of eight bits. A byte was the number of bits used to encode a single character of text in a computer and for this reason it is the basic addressable element in many computer architectures.

A kilobyte (kB) is 1024 bytes. The reasoning behind it being 1024 and not 1000 is that we use powers of 2, not 10, to represent binary numbers. (NOTE: the small k on kB). 1kB of memory could store roughly one full A4 page of text.

A megabyte (MB) is 1024 kB or 220. 1 MB is about the amount of data that is needed to store a full screen image, 1 minute of MP3 music, 6 seconds of uncompressed CD audio or a typical book.

A gigabyte (GB) is 1024 megabytes or 230 bytes. 1 GB is enough data for one hour of standard video, 7 minutes of high definition video or 114 minutes of uncompressed CD quality audio. A dual layered Blu-ray disc can hold about 25-100GB.

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A terabyte (TB) is 1024 gigabytes or 240 bytes. This is a difficult amount to comprehend, but Yahoo!® groups have about 40 terabytes of stored data. The first 1TB hard drive was produced in 2007. Ancestry.com claims approximately 600 TB of genealogical data with the inclusion of US Census data from 1790 to 1930. Released in 2009, the 3D animated film Monsters vs. Aliens used 100 TB of storage during development. The first 20 years' worth of observations by the Hubble Space Telescope has amassed more than 45 terabytes of data

Why does data need to be converted into a binary format to be processed by a computer?
Binary is a number base that only uses 1's and 0's. The computer understands binary as voltage on (1) or voltage off (0) signals. If the decimal system were used, there would need to be 10 different voltages, in which case there would be more room for error when testing for a voltage, and therefore a greater possibility of corruption of data
Define the terms bit, nibble, byte, kilobyte, megabyte, gigabyte, terabyte.

4 bits = 1 nibble 8 bits = 1 byte

1024 bytes	=	2^{10} bytes	=	1 Kilo Byte
1024 K B	=	2^{20} bytes	=	1 Mega Byte
1024 M B	=	2^{30} bytes	=	1 Giga Byte
1024 G B	=	2^{40} bytes	=	1 Tera Byte
1024 T B	=	2^{50} bytes	=	1 Peta Byte

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Binary-to-Denary Conversion:

Binary notation is used to convert binary number into denary numbers.

For example 100111_2 can be expressed as:

100111_2

$= 1 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$= 1 \times 32 + 0 \times 16 + 0 \times 8 + 1 \times 4 + 1 \times 2 + 1 \times 1$

$= 32 + 0 + 0 + 4 + 2 + 1$

$= 39_{10}$

Short-cut method

Binary Value	1	0	0	1	1	1
Binary Notation	32	16	8	4	2	1
Ignore notations under 0 bits	32	0	0	4	2	1
Add the remaining numbers	32+4+2+1					
Equivalent denary number	39					

Denary-to-Binary Conversion:

Binary notation is used to convert a denary number into binary numbers.

For example 120_{10} can be expressed as:

120_{10}

Binary Notation:

=128 64 32 16 8 4 2 1

Put the 1 under notations which are required to find sum equals to the number and 0 in remaining places as 64+32+16+8=120

=	128	64	32	16	8	4	2	1
=	0	1	1	1	1	0	0	0

1.1.2 Hexadecimal Number System:-

"The number system which is based on 16 characters from 0 to 9 and A, B, C, D, E & F is called Hexadecimal system."

The reason for the common use of hexadecimal numbers is the relationship between the numbers 2 and 16. Sixteen is a power of 2 (16 = 24). Because of this relationship, four digits in a binary number can be represented with a single hexadecimal digit.

The weights of digits according to their positions are given below:

Position	5^{th}	4^{th}	3^{rd}	2nd	1^{st}
Place Value (Hexadecimal Notation)	16^4=65536	16^3=4096	16^2=256	16^1=16	16^0=1

	Binary	Denary	Hexadecimal
Zero	0	0	0
One	1	1	1
Two	10	2	2
Three	11	3	3
Four	100	4	4

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	Binary	Denary	Hexadecimal
Five	101	5	5
Six	110	6	6
Seven	111	7	7
Eight	1000	8	8
Nine	1001	9	9
Ten	1010	10	A
Eleven	1011	11	B
Twelve	1100	12	C
Thirteen	1101	13	D
Fourteen	1110	14	E
Fifteen	1111	15	F
Sixteen	10000	16	10
Seventeen	10001	17	11

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Uses of Hexadecimal System:

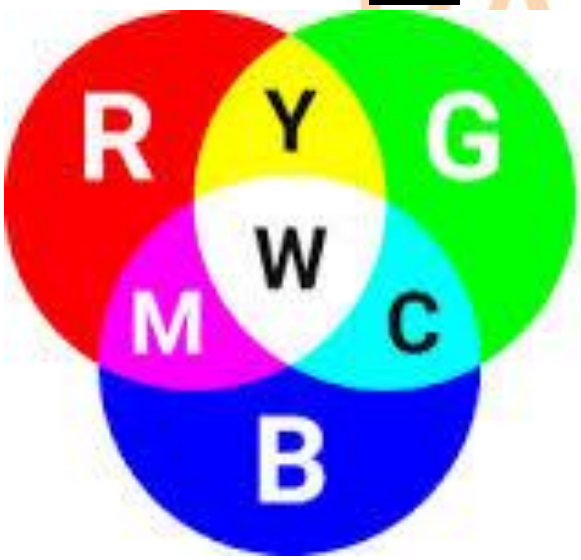
Uses of Hexadecimal in HTML:

Hyper Text Mark-up Language is used to develop Websites. In HTML a colour is specified according to the intensity of its Red, Green and Blue (RGB) components, each represented by eight bits. Thus, there are 24 bits used to specify a web colour, and 16,777,216 colours that may be so specified. It's easier for the human programmer to represent a 24-bit integer, often used for 32-bit colour values, as #FF0099 instead of 111111110000000010011001

	BINARY (BITS)					HEX	
	1	1	1	1	=	F	RR
	1	1	1	1	=	F	
	0	0	0	0	=	0	GG
	0	0	0	0	=	0	
	1	0	0	1	=	9	BB
	1	0	0	0	=	8	
	111111110000000010011001					FF0099	

HTML TAG Name

RED (RED)
GREEN (GREEN) LIME
BLUE (BLUE)
YELLOW (YELLOW)
MAGENTA (MAGENTA) FUCHSIA
CYAN (CYAN) AQUA



Uses of Hexadecimal in MAC Address:

Media Access Control assigns a unique number to each IP network adapter called the MAC address. A MAC address is 48 bits long. So we can assign MAC address to 281 billion computers. The MAC address is commonly written as a sequence of 12

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hexadecimal digits as follows:

48-3F-0A-91-00-BC

Instead of 48 bits which are

0100 1000 0011 1111 0000 1010 1001 0001 0000 0000 1011 1100

Uses of Hexadecimal in Debugging:

Debugging allows programmers to detect, diagnose, and eliminate errors in a program. The source debugger uses the hexadecimal values of the characters. Hex is often used in error messages. The hex number refers to the memory location of the error. This helps programmers to find and then fix problems.

Uses of Hexadecimal in Assembly Language:

In low level Assembly language programming, to address low level components, we are using addresses with hexadecimal value. To write out 11010101110100110010001100110000 it is easier to write and spell 0xd5d32330, and far less likely to evoke an error in writing or copying.

Character Set:

Text and numbers can be encoded in a computer as patterns of binary digits. Hexadecimal is a shortcut for representing binary. ASCII and Unicode are important character sets that are used as standard.

ASCII (American Standard Code for Information Interchange)

The ASCII character set is a 7-bit set of codes that allows 128 different characters. That is enough for every upper-case letter, lower-case letter, digit and punctuation mark on most keyboards. ASCII is only used for the English language.

This table shows some examples of letters represented using the ASCII character set:

Character	Denary Value	Binary Value	HEX	Character	Denary Value	Binary Value	HEX
A	65	1000001	41	N	78	1001110	4E
B	66	1000010	42	O	79	1001111	4F
C	67	1000011	43	P	80	1010000	50
D	68	1000100	44	Q	81	1010001	51
E	69	1000101	45	R	82	1010010	52
F	70	1000110	46	S	83	1010011	53
G	71	1000111	47	T	84	1010100	54
H	72	1001000	48	U	85	1010101	55
I	73	1001001	49	V	86	1010110	56
J	74	1001010	4A	W	87	1010111	57
K	75	1001011	4B	X	88	1011000	58
L	76	1001100	4C	Y	89	1011001	59
M	77	1001101	4D	Z	90	1011010	5A

Extended ASCII

Extended ASCII code is an 8-bit character set that represents 256 different characters, making it possible to use characters such as é or ©. Extended ASCII is useful for

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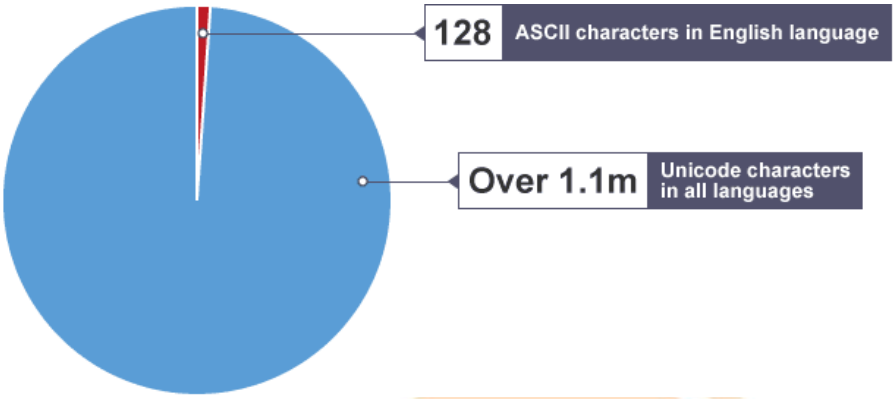
European languages.

Unicode

Unicode uses between 8 and 32 bits per character, so it can represent any characters from languages from all around the world. It is commonly used across the internet. As it is larger than ASCII, it might take up more storage space when saving documents.

Global companies, like Facebook and Google, would not use the ASCII character set because their users communicate in many different languages.



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ASCII Code

DEC	HEX	BIN	Symbol	DEC	HEX	BIN	Symbol	DEC	HEX	BIN	Symbol
0	00	00000000	NUL	43	2B	00101011	+	86	56	01010110	V
1	01	00000001	SOH	44	2C	00101100	,	87	57	01010111	W
2	02	00000010	STX	45	2D	00101101	-	88	58	01011000	X
3	03	00000011	ETX	46	2E	00101110	.	89	59	01011001	Y
4	04	00000100	EOT	47	2F	00101111	/	90	5A	01011010	Z
5	05	00000101	ENQ	48	30	00110000	0	91	5B	01011011	[
6	06	00000110	ACK	49	31	00110001	1	92	5C	01011100	\
7	07	00000111	BEL	50	32	00110010	2	93	5D	01011101	]
8	08	00001000	BS	51	33	00110011	3	94	5E	01011110	^
9	09	00001001	HT	52	34	00110100	4	95	5F	01011111	_
10	0A	00001010	LF	53	35	00110101	5	96	60	01100000	`
11	0B	00001011	VT	54	36	00110110	6	97	61	01100001	a
12	0C	00001100	FF	55	37	00110111	7	98	62	01100010	b
13	0D	00001101	CR	56	38	00111000	8	99	63	01100011	c
14	0E	00001110	SO	57	39	00111001	9	100	64	01100100	d
15	0F	00001111	SI	58	3A	00111010	:	101	65	01100101	e
16	10	00010000	DLE	59	3B	00111011	;	102	66	01100110	f
17	11	00010001	DC1	60	3C	00111100	<	103	67	01100111	g
18	12	00010010	DC2	61	3D	00111101	=	104	68	01101000	h
19	13	00010011	DC3	62	3E	00111110	>	105	69	01101001	i
20	14	00010100	DC4	63	3F	00111111	?	106	6A	01101010	j
21	15	00010101	NAK	64	40	01000000	@	107	6B	01101011	k
22	16	00010110	SYN	65	41	01000001	A	108	6C	01101100	l
23	17	00010111	ETB	66	42	01000010	B	109	6D	01101101	m
24	18	00011000	CAN	67	43	01000011	C	110	6E	01101110	n
25	19	00011001	EM	68	44	01000100	D	111	6F	01101111	o
26	1A	00011010	SUB	69	45	01000101	E	112	70	01110000	p
27	1B	00011011	ESC	70	46	01000110	F	113	71	01110001	q
28	1C	00011100	FS	71	47	01000111	G	114	72	01110010	r
29	1D	00011101	GS	72	48	01001000	H	115	73	01110011	s
30	1E	00011110	RS	73	49	01001001	I	116	74	01110100	t
31	1F	00011111	US	74	4A	01001010	J	117	75	01110101	u
32	20	00100000		75	4B	01001011	K	118	76	01110110	v
33	21	00100001	!	76	4C	01001100	L	119	77	01110111	w
34	22	00100010	"	77	4D	01001101	M	120	78	01111000	x
35	23	00100011	#	78	4E	01001110	N	121	79	01111001	y
36	24	00100100	$	79	4F	01001111	O	122	7A	01111010	z
37	25	00100101	%	80	50	01010000	P	123	7B	01111011	{
38	26	00100110	&	81	51	01010001	Q	124	7C	01111100	|
39	27	00100111	'	82	52	01010010	R	125	7D	01111101	}
40	28	00101000	(	83	53	01010011	S	126	7E	01111110	~
41	29	00101001	)	84	54	01010100	T	127	7F	01111111	
42	2A	00101010	*	85	55	01010101	U				

URL can be represented in hexadecimal using ASCII Codes.

Each hex digit is followed by %

w	w	w	.	r	u	k	n	u	d	d	i	n	.	c	o	m
%77	%77	%77	%2E	%72	%75	%6B	%6E	%75	%64	%64	%69	%6E	%2E	%63	%6F	%6D

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Conversion:

Convert a denary number into a binary number:

To convert a denary number into a binary number, create a binary notation in column diagram where the leftmost column heading is greater than the denary number and follow this algorithm (Note: Algorithm is series of steps to solve a problem):

1. Start on the left of the diagram.
2. If the column heading is less than the denary number:
   a. Put a 1 in the column.
   b. Subtract the column heading from the denary number.
   c. Move to the next column to the right.
3. d. Go to step 2.
4. If the column heading is greater than the number:
   a. Put a 0 in the column.
   b. Move to the next column to the right.
   c. Go to step 2.

You are normally only expected to be able to do this with numbers up to 255, because that is the biggest number that can be stored in one byte. You may be asked to use more bits for larger numbers.

As an example, we change the denary number 117 into a binary number. First, we set up the column diagram up to column heading 128 (which is larger than 117).

128	64	32	16	8	4	2	1

Algorithm of conversion is given below:

Conversion of Denary into Binary									
Steps	Steps from above Algorithm Binary Notation	128	64	32	16	8	4	2	1
1	128 is greater than 117 so put 0 in the column of 128	0							
2	64 is less than 117 so put 1 in 64's column	0	1						
3	117-64=53 ➔ 32 is less than 53 so put 1 in 32's column	0	1	1					
4	53-32=21 ➔ 16 is less than 21 so put 1 in 16's column	0	1	1	1				
5	21-16= 5 ➔ 8 is greater than 5 so put 0 in 8's column	0	1	1	1	0			
6	4 is less than 5 so put 1 is 4's column	0	1	1	1	0	1		
7	5-4=1 ➔ 2 is greater than 1 so put 0 in 2's column	0	1	1	1	0	1	0	
8	1=1 so put 1 in 1's column	0	1	1	1	0	1	0	1

Then we follow the algorithm.

- 128 is greater than 117 so put a 0 in the 128s column and move to the 64s column
- 64 is less than 117 so put a 1 in the 64s column, subtract 64 from 117 (117-64= 53) and move to the 32s column.
- 32 is less than 53, so put a 1 in the 32s column, subtract 32 from 53 (53-32= 21) and move to the 16s column.
- 16 is less than 21, so put a 1 in the 16s column, subtract 16 from 21 (21-16=5) and move to the 8s column.
- 8 is greater than 5, so put a 0 in the 8s column and move to the 4s column.
- 4 is less than 5, so put a 1 in the 4s column, subtract 4 from 5 (5-4=1) and move to the 2s column.
- 2 is greater than 1, so put a 0 in the 2s column, and move to the 1s column.
- 1 is equal to 1, so put a 1 in the 1s column.

128	64	32	16	8	4	2	1
0	1	1	1	0	1	0	1

So 117 (in denary) = 01110101 (in binary).

Convert a binary number into a denary number:

To turn a binary number into denary, simply put the binary notation below the binary number and add up all the binary notation numbers of each column with a 1 in it.
As an example, we change the binary number 10110110 into a denary number.

Conversion of Binary into Denary								
Binary Number	1	0	1	1	0	1	1	0
Binary Notation	128	~~64~~	32	16	~~8~~	4	2	~~1~~
Calculation (Multiply each bit by its place value and add them together.	~~1x128+0x64+1x32+1x16+0x8+1x4+1x2+0x1~~ = 128 + 32 + 16 + 4 + 2							
Denary Number	~~182~~							

128 + 32 + 16 + 4 + 2 = 182
So 10110110 = 128 (in denary).

Convert a denary number into a Hexadecimal number:

To convert a denary number into a hexadecimal number, create a hexadecimal notation in column diagram where the leftmost column heading is greater than the denary number and follow this algorithm:

Convert a binary number into a hexadecimal number

Divide into groups of 4 bits
Write down binary notation under each group
Ignore the numbers below 0s and add up the numbers below 1s
If sum any 4-bit group is 10 then write A as A represents 10 in hexadecimal. Apply the same in case of 11 (B), 12 (C), 13 (D), 14 (E) and 15 (E)

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For Example:
Convert the binary number 10110101 to a hexadecimal number

Conversion of Binary into Hexadecimal		
Groups of 4 bits	1 0 1 1	0 1 0 1
4 bit binary notation	8 4 2 1	8 4 2 1
Calculation (Multiply each bit by its place value and add them together.	1x8+0x4+1x2+1x1 =8+0+2+1 =11	0x8+1x4+0x2+1x1 =0+4+0+1 =5
Hex-decimal Number	B	5

$10110101_2 = B5_{16}$

Convert a hexadecimal number into a binary number

Write down binary notation under each hexadecimal digit
Find out the binary notations numbers total of which equals the hexadecimal digit and place 1s below these numbers
Place 0s below remaining binary notation number.
For example: Convert the hex number 374F into binary

Conversion of Hexadecimal into Binary				
Hexadecimal Number	3	7	4	F
	3	7	4	15
4 Bit Binary Notation	8 4 2 1	8 4 2 1	8 4 2 1	8 4 2 1
Calculation (Write 1s under binary notation number total of which equals the hexadecimal digit	0 0 1 1 (2+1=3)	0 1 1 1 (4+3+1=7)	0 1 0 0 (4=4)	1 1 1 1 (8+4+2+1=15)
Binary Numbers	0011011101001111			

3=2+1 so 1s are written below 2 and 1 and 0s are written below 8 & 4.
7=4+2+1 so 1s are written below 4, 2 and 1 and 0s are written below 8.
4=4 so 1 is written below 4 and 0s are written under 1, 2 & 8.
F=15=8+4+2+1 so 1s are written under all of them.

$374F_{16} = 0011011101001111_2$

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Examination Questions

Q 1) When texts are transferred large amounts of data are transmitted.
The characters are sent as ASCII characters.
Explain what is meant by an ASCII character.

.....
.....
..... [2]

Q 2) Specimen 2015 P1 (Q13)

When a key is pressed on the keyboard, the computer stores the ASCII representation of the character typed into main memory. The ASCII representation for A is 65 (denary), for B is 66 (denary), etc.
There are two letters stored in the following memory locations:

Location 1	A
Location 2	C

(a) (i) Show the contents of Location 1 and Location 2 as binary.
Location 1 ,..... .....
Location 2 ....[2]
(ii) Show the contents of Location 1 and Location 2 as hexadecimal.
Location 1 ,.....
Location 2 ....[2]
(b) The following machine code instruction is stored in a location of main memory:

1	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1

Convert this binary pattern into hexadecimal.

.....
..... [4]

c) Explain why a programmer would prefer to see the contents of the locations displayed as hexadecimal rather than binary, when debugging his program that reads the key pres ses.

.....
..... [2]

Q 3) Here are the contents of three memory locations with addresses shown in denary.

Address	Memory contents
150	0100 0111
151	1100 1101
152	1001 1100

(a) (i) What is the binary value for address 150?

....
..... [1]
(ii) What is the hexadecimal value for the contents of address 152?

.....
..... [1]

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(b) The numbers in location 151 and 152 are the height and width (in pixels) of a bitmap graphic currently in main memory. What are the dimensions of the bitmap in denary?

Height: _____ pixels

Width: _____ pixels [2]

(c) A bitmap graphic can be saved in a number of different image resolutions.

(i) How many bits are required to store each pixel for a black and white bitmap?

..... [1]

(ii) For a 256-colour bitmap, each pixel requires a byte of memory.

Explain this statement.

..... [2]

Q 4) (9691_w13_p13)

(a) (i) A positive integer is represented in binary as 10101101 .

What is the denary value?

..... [1]

(ii) How would the denary value 73 be represented as a positive binary integer?

..... [1]

Q 5) Calculate the denary value of the 8-bit binary number 10010111.

You must show your working.

..... [2]

Q 6) (a) Explain how ASCII is used to represent text in a computer system.

..... [3]

(b) State what is meant by the character set of a computer.

..... **[1]**

(c) Unicode is also used to represent text in a computer system.

Explain the difference between the character sets of Unicode and ASCII.

..... [2]

Q 7) Express the number 113 (denary) in binary in a byte.

..... **[2]**

(a) Change 83 into a binary number stored in an 8 bit byte.

..... **[2]**

Q 8a) **(i)** Change the denary integer 120 into a binary number.

..... **[2]**

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(ii) Change the binary number 1011011011 into a positive denary integer.

.....
..... [1]

The security code for an alarm system is a long binary number which begins

100111101000110101111010

b) The technicians prefer to use hexadecimal number to enter security code.

(i) When the number is converted into hexadecimal, the first two digits are 9E as shown below:

Complete the gaps to show next three digits. [4]

Binary:	1001	1110	1000	1101	0111	1010
Hexadecimal:	9	E	__	__	__	__

(ii) Change the hexadecimal number 5A into a binary number.

.....
.....**2]**

(iii) Explain why technicians prefer to use hexadecimal numbers.

.....
..... **[3]**

Q 9) Convert denary number 55 into a 10 bit binary number.

.....
..... **[1]**

a) Convert denary number 55 into a 10 hexadecimal number.

.....
..... **[1]**

b) The memory of computer contains data and instructions in binary. Explain why computers use binary.

.....
.....
..... **[3]**

Q 10) (a) Explain why data is stored in computers in a binary format.

.....
.....
..... **[2]**

(b) In the ASCII character set, the character codes for the first three capital letters are giv en below:

Letter	ASCII character code
A	0100 0001
B	0100 0010
C	0100 0011

(i) State how the ASCII character set is used to represent text in a computer.

.....

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.....
..... [1]

(ii) Convert the word CAB into binary using the ASCII character set.

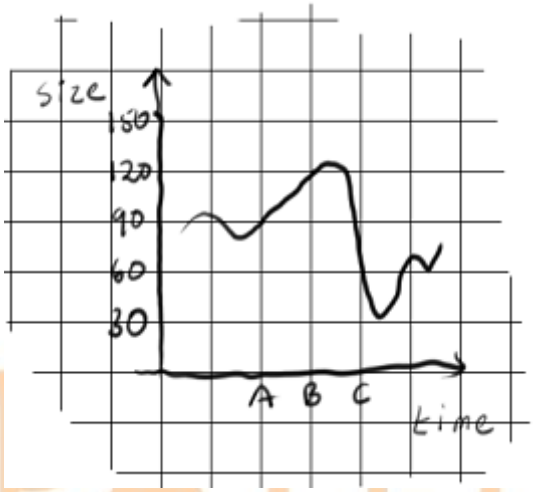
.....
.....
..... [1]

(iii) Explain why the ASCII character set is **not** suitable for representing text in all t he languages of the world.

.....
.....
..... [1]

Q 11)

An artist is recording sound using a computer. The graph below represents the pressure wave of the sound being recorded.



(i) At point A on the graph, the size of the sound wave is 90. This is stored digitally using the binary value of 0101 1010 (or 5A in Hex).
Complete the table below to show how points B and C are stored:

	Point A	Point B	Point C
Size	90		
Binary Value	0100 1000		
Hex Value	5 A		

Convert the denary number 106 into an 8 bit binary number.

.....
..... [1]

(ii) Convert the denary number 106 into Hexadecimal.

.....
..... [1]

(iii) Convert the hexadecimal number 7F into denary.

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.....
..... [1]

(iv) Convert the denary number 291 into hexadecimal.

.....
..... [1]

(v) Why do computer scientists often write binary numbers in hexadecimal?

.....
..... [1]

(vi) Convert the denary number 60 into hexadecimal.

.....
..... [1]

(vii) Convert the hexadecimal number 10F into denary.

.....
..... [1]

(viii) Convert the hexadecimal number 7A to denary.

.....
..... [1]

(ix) Convert the binary number 0101 1100 to hexadecimal.

.....
..... [1]

(x) A positive integer is represented in binary as 10101101 .
What is the denary value?

.....
..... [1]

(xi) How would the denary value 73 be represented as a positive binary integer?

.....
..... [1]

(xii) Binary representation is used for many different data values.
Consider the binary pattern 1010 0110. What is its value if it represents in denary?

.....
..... [1]

a hexadecimal number?

.....
..... [1]

(xiii) A computer system stores real numbers in floating point format using 12 bits. The first 8 bits are the mantissa and the final 4 bits the exponent. Both the mantissa and the exponent use two's complement format. Consider the binary pattern 0101 1000 0101 what is the exponent in denary?

.....
..... [1]

(xiv) A binary pattern can be used to represent different data used in a computer system.

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Consider the binary pattern: 0101 0011
The pattern represents an integer. What number is this in denary?

..... [1]

(xv) Change the denary integer 222 into a binary number, using 10 bits.

..... [1]

(xvi) Change the binary number 01101100 into a positive denary integer.

..... [1]

(xvii) Change the denary integer 278 into a binary number, using 10 bits.

..... [1]

(xviii) Change the binary number 10101100 into a positive denary integer.

..... [1]

(xix) The number of visits made by a member during the year is stored as an integer in a single byte. Mr Jyu has visited 135 times. Change 135 into the binary representation for the computer to store.

..... [1]

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1.1.3 Data storage

Computers understand 1s and 0s. The information about the real world, like images and sound, is in analogue. This analogue information is firstly converted in digital format to store in computer.

Images:

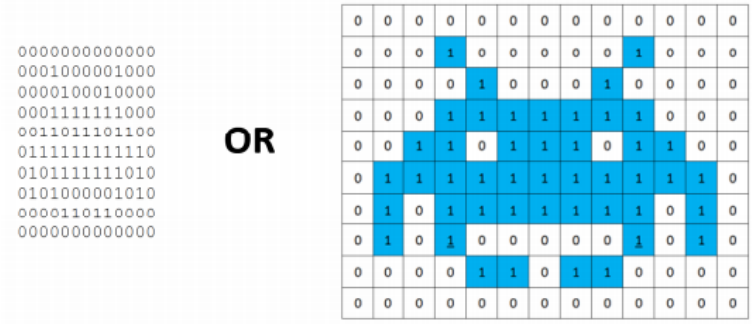
A **Pixel (picture element)** is the smallest unit of data that can be represented in an image. Each pixel can represent a single, solid block of colour.

Vector Graphics

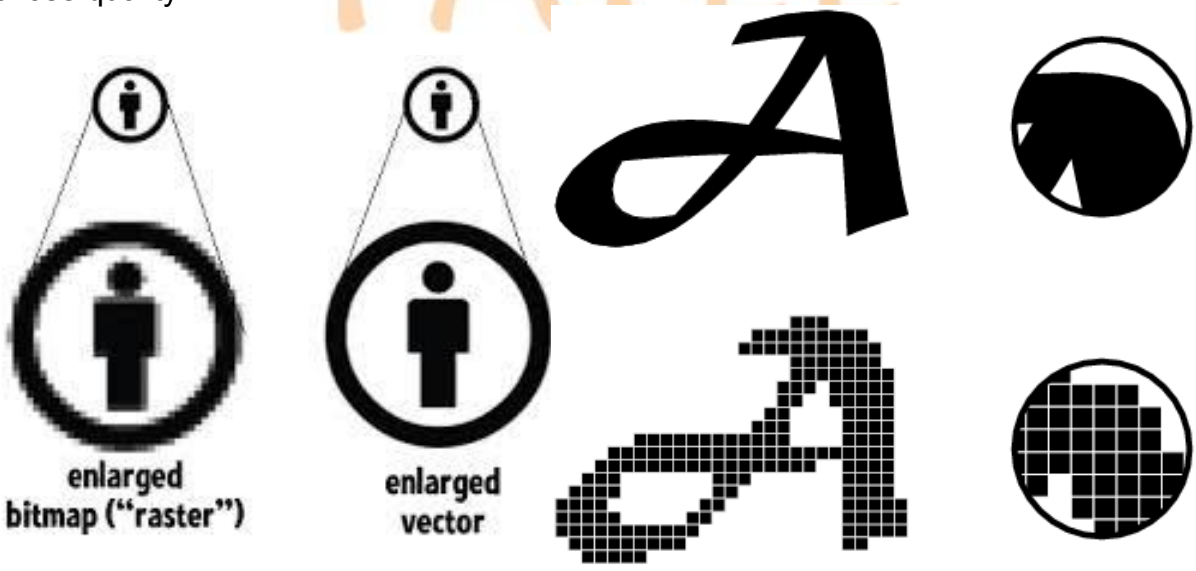
Vector images store set of instructions about HOW to draw each shape.
Vector graphics are created in graphics packages and consist of shapes called objects. It is possible to edit each object separately, for example, change the shape, colour, size and position.
The file size of a vector graphic is often very small.
Vector graphic is scalable – i.e. when you resize it, the entire image is redrawn and it doesn't lose quality.

Bitmap Graphics

A bitmap or Raster image is a group of pixels. The colour of each pixel is stored as a binary code. The following picture could be represented as:



Since the computer has to store information about every single pixel in the image, the file size of a bitmap graphic is often quite large. When you resize a bitmap graphic, it tends to lose quality.



Colour Depth:

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The more bits are used to represent each pixel, the more combinations of binary numbers are possible, and so more colours are possible in the image. This is known as colour depth.

Colour Depth	Number of Colours Represented	Working
1 bit	2 (0, 1) (e.g. black & white)	$2^1=2$
2 bit	4 (00, 01, 10, 11)	$2^2=4$
4 bit	16 (0000, 0001, 0010, 0011, 0100, 0101, 0110, 0111, 1000, 1001, 1010, 1011, 1100, 1101, 1110, 1111)	$2^4=16$
8 bit	256	$2^8=256$
16 bit	65,536	$2^{16}=65,536$
24 bit	16,777,216	$2^{24}=16,777,216$

JPG or JPEG (Joint Photographic Experts Group)

This is a compressed bitmap image file format commonly used for photographs. You can choose how much compression you want, so for a small image on a web page a large compression factor can be chosen for a small file size.

- Preferred format for **scanned photographic images** for use over the internet or

Web.
- Not meant for printing.
- Not good for images with a lot of solid color, vector drawings, type, or line art or images with "Web-safe" colors.
- JPEG compression is **lossy**! Save and archive the original before converting to JPEG.
- JPEG files are reduced by factor of 5 to 15. Factor of 15 means 85% file size is reduced and compressed file size is 15% of original size.

GIF (Graphics Interchange Format)

GIF files are a format commonly used for simple animation presented on websites. GIFs can contain a maximum of 256 colors, and are therefore best for images that contain simple shapes, a limited color palette, text and other elements as opposed to photos.

- Industry standard graphic format for on-screen viewing through the Internet and Web.
- Not meant to be used for printing.
- GIF supports lossless compression.

PDF (Portable Document Format)

This is an open standard for exchanging documents. Text and graphics are displayed exactly as in the original, with no need to have the software that created the document. Many applications are capable of reading or creating PDF documents.

- Developed to transfer and read documents without having to print them—the "paperless office."
- Can represent both vector and bitmap graphics.
- Can also contain electronic document search and navigation features as well as hypertext links.
- Can be created from almost any application.
- Document formatting, fonts, colors, etc. are maintained and appear identical across platforms.

MP3 (Moving Pictures Expert Group Audio Layer 3)

This has become the standard for distributing digital music files on the internet. It uses lossy compression to reduce file sizes to about a tenth of the original.
The compression algorithm is intended to remove sounds that are generally beyond the limits of most people's hearing and does not noticeably affect the quality of sound.
When using MP3 format, the size of the music track will be reduced by a factor of 10 (i.e. the size is reduced by 90% and remaining file size is only 10% of original size).

Try yourself:

MP3 file compression reduces the size of a music file by 90%.
(a) A music track is 80 MB in size.
Calculate the file size after compression.

.....

How many MP3 files of the size calculated above could be stored on an 800 MB CD?

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.....[2]

(b) (i) Explain how MP3 files retain most of the original music quality.

.....
.....
.....
.....
..... [2]

(ii) State the type of file compression used in MP3 files.

..... [1]

(iii) Name another file compression format.

..... [1]

The following statistics refer to a music track being recorded on a CD:

- music is sampled at 44100 times per second
- each sample is 16 bits
- each track requires separate sampling for left and right speakers of a stereo recording

(8 bits = 1 byte, 1 megabyte = 1048576 bytes)

(a) (i) How many bytes are required to represent one second of sampled music?

.....
.....
.....
.....
..... [2]

(ii) If a typical music track is 3 minutes long, how much memory is used on the CD to store one track? (Give your answer in megabytes.)

.....
.....
.....
.....
..... [2]

(b) When using MP3 format, the size of the above music track will be reduced by a factor of 10 (i.e. the size is reduced by 90%).

How is the music quality retained?

.....
.....
.....
.....
..... [2]

Marking Scheme

(a) (i) 44 100 × 16 × 2 = 1 411 200 bits/second

1 411 200/8 = 176 400 (bytes)

(two marks for correct answer. If answer is incorrect, award one mark for a good attempt at the calculation.) [2]

(ii) 3 minutes = 180 seconds

176 400 × 180 = 31 752 000 bytes

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= 30.281 (megabytes) (allow 0, 1, 2 or more decimal places)
(two marks for correct answer. If answer is incorrect, award one mark for a good attempt at the calculation, allowing follow through from (i)) [2]
(b) Any one from:
– similar to how ZIP/Jpeg files work
– file is compressed
– lossless compression
AND
Any one from:
– using perceptual music shaping
– uses human ear characteristics to remove unneeded data//removes sounds that the human ear can't hear
– only keeps the sounds that the human ear hears better than others
– if 2 sounds played together, human ear can only hear louder one and not the softer one which is consequently discarded [2]

MPEG (Moving Pictures Expert Group)

This is a set of standards designed to encode audio/visual information. It uses lossy compression for both the sound and the visual components. Various versions of MPEG are used for digital transmissions, such as via cable and satellite, as well as terrestrial digital channels. It is used to encode DVD movies as well and can be decoded by most domestic DVD players.

File Type	Extension	Comments
Motion Picture Experts Group	mp3	Preferred format for up/downloading files online. File size quite small due to lossy compression.
Windows Waveform	wav	Often used to store uncompressed, CD-quality sound files that tend to be very large (approx. 10 MB/minute)
Audio Interchange File Format	aiff	Standard audio file format used by Apple.
Musical Instrument Digital Interface	midi	Not an actual recording of music, but a set of instructions on how to play the music that can be understood by any device. Very small file sizes.
Windows Media Audio	wma	Lossy format for use on Windows OS.

MIDI

Pronounced *middy*, an acronym for ***m**usical **i**nstrument **d**igital **i**nterface*, a standard adopted by the electronic music industry for controlling devices, such as synthesizers and sound cards, which emit music. At minimum, a MIDI representation of a sound includes values for the note's pitch, length, and volume. It can also include additional characteristics, such as attack and delay time.

Importance of compressing Files

File compression is the process of encoding information using fewer bits so that the compressed file size is smaller.

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It is important for files transmitted over the Internet because if they are not compressed then there would be considerably more data to transmit. This would result in more network traffic, slower download times and delays in viewing web pages, particularly those with multimedia content. Streaming audio and video would be impractical without file compression.

However, compressed data may be of lower quality (if using lossy compression) and must be decompressed to be used. This extra processing may slow some applications and in the case of video decompression, require dedicated hardware such as graphics cards for the video to be viewed as it is actually being decompressed.

Lossless compression

This allows the original file to be re-created exactly from the compressed file. It works by searching for patterns in the file so, instead of repeatedly storing a block of identical data; the data is stored once and then indexed. Further occurrences are simply stored as the index number so the decompression software can simply look up the data and place it back in the correct position.

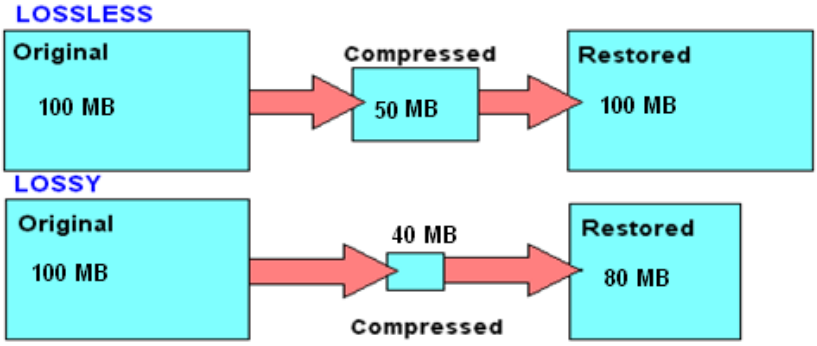
Text files compress well because certain letters and words will often appear together in the same pattern. Software files also compress well for similar reasons, they are made up of a relatively small number of different instructions, often arranged in a set pattern. In both cases, the larger the original file, the better the compression ratio as there are more likely to be repeating patterns and each pattern will be repeated more frequently.

Lossy compression

Files that include a lot of unique information, such as bitmap graphics, sound or video files, cannot be compressed much with lossless compression because there is so little repeated data.

Lossy compression works differently, it removes data that is not needed, either because a drop in quality is acceptable or the difference cannot be detected by the human eye or ear.

Streaming audio and video is possible with lossy compression.



2 Seven computer terms and seven descriptions are shown below.

Draw a line to link each computer term to its most appropriate description.

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Interface	Reduction of file size by permanently removing some redundant information from the file
Interrupt	File compression format designed to make photo files smaller in size for storage and for transmission
JPEG	File compression system for music which does not noticeably affect the quality of the sound
Lossless compression	Hardware component that allows the user to communicate with a computer or operating system
Lossy compression	The file is reduced in size for transmission and storage; it is then put back together again later producing a file identical to the original
MIDI	Signal sent to a processor which may cause a break in execution of the current routine, according to priorities
MP3 format	Standard adopted by the electronic music industry for controlling devices such as synthesisers and sound cards

[6]

Examination Questions:

Q 12) Files are often compressed before they are transmitted over the internet.

a) State what is meant by compression.

.....
..... **[2]**

b) State one advantage of file compression before sending them over internet.

.....
..... **[2]**

c) Two types of file compressions are lossy and lossless.
State which compression type is most appropriate for each of the following and explain why it is appropriate.

(i) Downloading source code of a large program
Type of Compression: ....
Explanation: .....
..... [3]

i) Streaming a large video file

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Type of compression: ....
Explanation: .....
..... [3]

Q13) Bitmaps may use compression techniques to reduce the file size.
Explain the difference between 'lossless' and 'lossy' techniques for achieving this compression.

.....
..... [4]

Q 14) A student has a stand-alone computer at home.
Describe the following examples of utility software and state how they would be used by the student.
File compression
Description: .....
..... [2]
Use: .....
..... [1]

Q15) Some students decide to do a survey to find out how good the general public are at Mathematics. These surveys produced a lot of data. The students decided to run a file compression utility.
(i) Describe why file compression would be useful in this application.

.....
.....
..... [2]

(ii) The students frequently send each other email with file attachments. Describe two different file types where compression can be used.
1.....
.....
2.....
.....
.....[2]

Q 16)A website is made up of different types of files.
State what each of the file types in the table below is used for. [4]

File Type	Use
HTML	
JPG	
PDF	
MP3	

Error Detection and Correction

Parity Checks

This is used to check data following potential transmission errors; an extra binary digit is added to each binary number before transmission. Systems that use EVEN parity have an even number of 1s; systems that use ODD parity have an odd number of 1's.

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For example, if a system uses EVEN parity and the number being transmitted is: 1101110 then an extra 1 is added to give the number even parity i.e. 11011101 ; but if the number being transmitted was: 1101100 then an extra 0 is added since the number already has an even number of 1s i.e. 11011000. The parity is checked at the receiving end to make sure none of the binary bits have been transmitted incorrectly.

Check digits

This is an extra digit added to a number which is calculated from the other digits; the computer recalculates the check digit after the number has been input. Check digits are used on bar code numbers and ISBN's. There are a number of ways that check digits are generated; in the example that follows, we will consider the **ISBN-10 method** which makes use of the *modulo 11 system.*
Example we will consider the number 0-221 -43256-?

(i) The position of each digit is first considered:

10	9	8	7	6	5	4	3	2	1 ← Digit Position
0	2	2	1	4	3	2	5	6	? ← Number

(ii) Each digit in the number is then multiplied by it's digit position and the totals are added together:
i.e. (0x10) + (2x9) + (2x8) + (1x7) + (4x6) + (3x5) + (2x4) + (5x3) + (6x2)
= 0+18+16+7+24+15+8+15+12
= 115 total

(iii) The total is then divided by 11 (modulo 11) and the remainder, if any, is subtracted from 11. The answer then gives the check digit.
i.e. 115/11 = 10 remainder 5
i.e. 11 – 5 = 6 (check digit)
hence, the final number is: 0-221-43256-6

Checksums

A checksum is a way of summarising a block of data such as a USB or a network data packet. At its simplest, it consists of the arithmetical sum of all the numerical values of all the elements of the block. The sum is reduced to a standard number of digits and transmitted with the block. When the block of data gets to its destination, the same mathematical calculation is performed on the data by the receiving device and the results is compared with the received checksum. If the two checksums match, the integrity of the data has been maintained. If the two checksums do not match then an error has been made in transmitting the data and the receiving device requests the sending device to re-transmit the data. Even if one binary digit has changed in the data, the recalculated checksum does not match the received checksum and the data are rejected.
Checksum is similar in function to a parity bit for a byte or a check digit for a code number. More complex implementations of checksum involve more complex arithmetic to try to detect a wider range of errors.

Algorithm of calculating Checksum:

Step 1: Find out the size of file i.e. x

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Step 2: IF file size (x)<256 then checksum = file size(x)
Step 3: IF file size >=256 then divide file size by 256 y is obtained (y=x/256)
Step 4: Round down the y
(ignore decimal part e.g. for y=3.9 ➔ y=3 and for y=3.1➔y=3)
Step 5: Multiply y by 256, z is obtained (z=y*256)
Step 6: Check sum is difference between z and x (Checksum=x-z)

For example: Suppose the value of X is 1185, then tracing through the algorithm, we get:
X = 1185
1 1185/256 = 4.629
2 Rounding down to nearest whole number gives Y = 4
3 Multiplying by 256 gives Z = Y * 256 = 1024
4 The difference (X – Z) gives the checksum: (1185 – 1024) = 161
5 This gives the checksum = 161

Calculate the checksum for blocks of data with the following byte sums:
a 148
b 905
c 1450
d 4095

Automatic Repeat reQuest (ARQ)

Automatic Repeat reQuest (ARQ), also known as Automatic Repeat Query, is an error control method for data transmission that uses acknowledgements (messages sent by the receiver indicating that it has correctly received a data frame or packet) and timeouts (specified periods of time allowed to elapse before an acknowledgment is to be received) to achieve reliable data transmission over an unreliable service. If the sender does not receive an acknowledgment before the timeout, it usually re-transmits the frame/packet until the sender receives an acknowledgment or exceeds a predefined number of retransmissions.

The types of ARQ protocols include

- Stop-and-wait ARQ
- Go-Back-N ARQ
- Selective Repeat ARQ

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Examination Questions:

Q 17) When data is transmitted between devices it can be corrupted. One method to det ect corruption is the use of a checksum.

Explain how a checksum can be used to detect the presence of errors in a transmission.

.....

.....

..... [4]

Q 18) The following bytes were sent during a data transmission:

0 0 1 1 0 0 0 1

1 0 0 1 1 0 1 1

1 1 1 0 0 0 0 0

Explain how a checksum is used to check whether the bytes have been corrupted during data transmission.

.....

.....

.....

.....

..... [3]

Q 19)9691_13w_qp11

Check digits are another validation method. The modulo-11 method multiplies each digit by its digit position, adds the totals together and divides the result by eleven. The remainder is the check digit.

Note: the check digit is digit position 1.

(i) Calculate the check digit (_) for the following number:

3 0 4 5 _

Show your working.

.....

.....

..... **[2]**

(ii) The employee ID 39421 was entered into the computer as 34921.

Explain how the check digit validation check will flag 34921 as an invalid employee ID.

.....

.....

..... **[2]**

Q 20) Specimen 2015, Winter 2011 qp12

A company selling CDs uses a unique 6-digit identification number for each CD title. The rightmost digit (position 1) is a check digit.

For example,

6	5	4	3	2	1	← digit position
3	0	6	1	4	9	← identification number

↑ check digit

The validity of the number and check digit is calculated as follows:

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• multiply each digit by its digit position
• add up the results of the multiplications
• divide the answer by 11
• if the remainder is 0, the identification number and check digit are valid.

(a) Show whether the following identification numbers are valid or not. You must show ho w you arrived at your answer.

Identification number 1: 4 2 1 9 2 3

working:.....
.....
.....

Valid or not valid?.....

Identification number 2: 8 2 0 1 5 6

working:.....
.....
.....

Valid or not valid?..... [3]

(b) Find the check digit for this identification number.

5 0 2 4 1 __

working: .....
.
.....
.....

Check digit ..... [2]

(c) Describe, with examples, two different types of data entry errors that a check digit wo uld detect.

1.....
.....

2 .....
..... **[2]**

Q 21**) Specimen 2011**

A system uses 8 digit numbers with an additional eighth digit used as a check digit.

(a) Give two types of error which can be detected using a check digit when transmitting data.

1.....
.....

2.....
.....[2]

(b) Each of the eight digits in the number has a digit position.

e.g. 8 7 6 5 4 3 2 1 ← digit position
3 0 5 5 1 6 2 5 ← digits (digit in position 1 is the check digit)

The validity of the check digit is found using the following calculation:

• multiply each digit by its digit position
• add together the results of the multiplications

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- divide the sum by 11
- If the remainder is ZERO then the number is valid

For example, in the above number we have a sum of 110. Dividing by 11 gives a remainder of 0.

Thus the number is valid. For each of the following 8 digit numbers, indicate whether they are valid or not. Show all working.

(i) 8 1 3 9 1 2 0 7

working: .....
.
.....
.....

Valid or not valid?..... [3]

(ii) 5 5 0 3 1 6 1 7

working: .....
..
.....
.....

Valid or not valid?.....[3]

PATEL

Using binary in registers

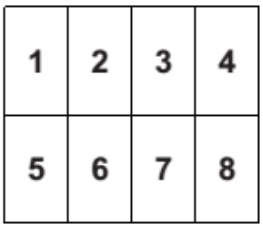
When computers (or microprocessors) are used to control devices, registers are used as part of the control system. The following exam questions describe how registers can be used in controlling a simple device.

Examination Questions

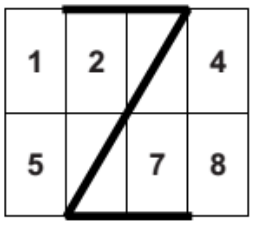
Q 22) Winter 14 P12

An advertising sign uses large LED characters controlled by a microprocessor.

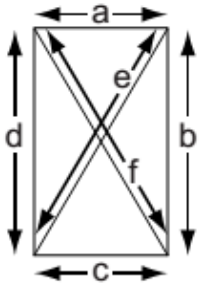
Each letter is formed from a grid made up of eight rectangles numbered 1 to 8:



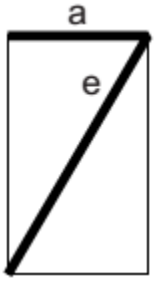
For example, the letter "Z" is formed as follows:



Each rectangle has six LEDs that can light up; these LEDs are labelled "a" to "f":



The LEDs in a rectangle can be represented in a 6-bit register. For example, rectangle 3 of the letter "Z":



can be represented as:

f	e	d	c	b	a
0	1	0	0	0	1

Thus the letter "Z" can be represented by the 8 registers:

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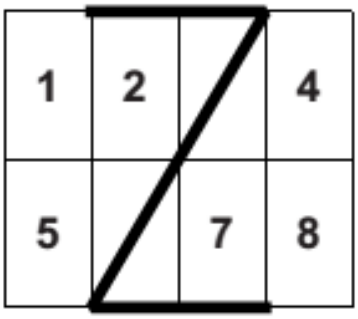
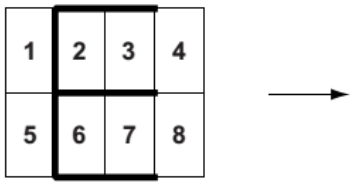


	f	e	d	c	b	a
1	0	0	0	0	0	0
2	0	0	0	0	0	1
3	0	1	0	0	0	1
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	1	0	1	0	0
7	0	0	0	1	0	0
8	0	0	0	0	0	0

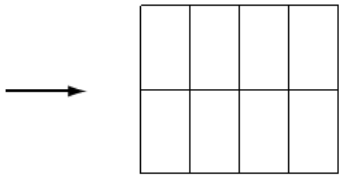
(a) Show how the letter "E" can be represented by the eight 6-bit registers (four registers have been done for you).



f	e	d	c	b	a	
0	0	0	0	0	0	1
						2
						3
0	0	0	0	0	0	4
0	0	0	0	0	0	5
						6
						7
0	0	0	0	0	0	8

(b) State which letter of the alphabet is represented by the following eight 6-bit registers.

f	e	d	c	b	a	
0	0	0	0	0	0	1
0	0	1	0	0	0	2
0	0	0	0	1	0	3
0	0	0	0	0	0	4
0	0	0	0	0	0	5
0	0	1	0	0	1	6
0	0	0	0	1	1	7
0	0	0	0	0	0	8



letter .....

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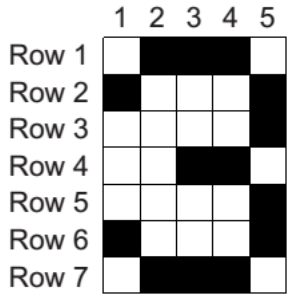
Q 23) Winter 2014 P13

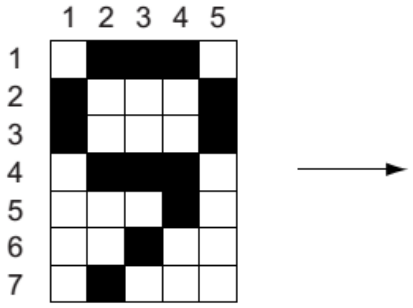
Digits on an electronic display board can be represented on a 7 × 5 grid. For example, the digit 3 is represented as:



Each column in the grid is represented in a computer as a 7-bit register. Five registers are required to represent the state of the whole digit. The value 1 represents a shaded square and the value 0 represents an unshaded square. For example, the digit 3 is represented as:

Row number:	1	2	3	4	5	6	7
Register 1	0	1	0	0	0	1	0
Register 2	1	0	0	0	0	0	1
Register 3	1	0	0	1	0	0	1
Register 4	1	0	0	1	0	0	1
Register 5	0	1	1	0	1	1	0

(a) Show the contents of the five 7-bit registers when representing the digit 9:



Row number:	1	2	3	4	5	6	7
Reg 1							
Reg 2							
Reg 3							
Reg 4							
Reg 5							

(b) In order to prevent errors, an 8-bit register is used. The 8th bit will contain:

- 0 – if the first 7 bits add up to an even number
- 1 – if the first 7 bits add up to an odd number

Complete the 8th bit for each register. The first register has been completed for you.

	1	2	3	4	5	6	7	8
Reg 1	0	1	0	0	0	1	0	0
Reg 2	1	0	0	0	0	0	1	
Reg 3	1	0	0	1	0	0	1	
Reg 4	1	0	0	1	0	0	1	
Reg 5	0	1	1	0	1	1	0	

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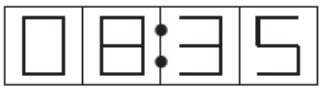
Q 24) Specimen 2015 P1

A digital alarm clock is controlled by a microprocessor. It uses the 24-hour clock system (i.e. 6 pm is 18:00). Each digit in a typical display is represented by a 4-digit binary code.

For example:



(clock display)

is represented by:

0	0	0	0	1st digit (0)
1	0	0	0	2nd digit (8)
0	0	1	1	3rd digit (3)
0	1	0	1	4th digit (5)

(a) What time is shown on the clock display if the 4-digit binary codes are: [2]

0	0	0	1
0	1	1	0
0	1	0	0
1	0	0	1

(clock display)

(b) What would be stored in the 4-digit binary codes if the clock display time was: [4]

				1st digit
				2nd digit
				3rd digit
				4th digit

(c) The clock alarm has been set at 08:00.

Describe the actions of the microprocessor which enable the alarm to sound at 08:00.

.....

..... [2]

Q 25)

Q 26) Summer 2013 P11

Letters from the Greek alphabet are to be transferred to a computer system. Each letter can be represented on an 8 by 8 grid. Each column has a value from 1 to 128.

The value of each row is stored in a table. The values in the column headings are used

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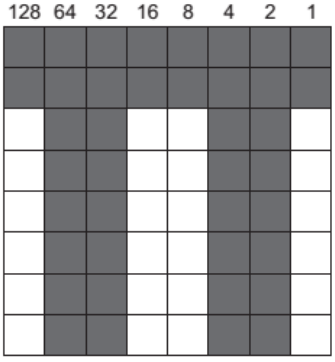
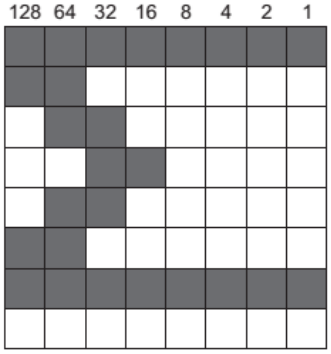
to work out the value for each row (e.g. in our example, row 8 has the value 64 + 32 + 4 + 2 = 102).

Thus, in the example below, the letter (π) is stored as:



row	value
1	255
2	255
3	102
4	102
5	102
6	102
7	102
8	102

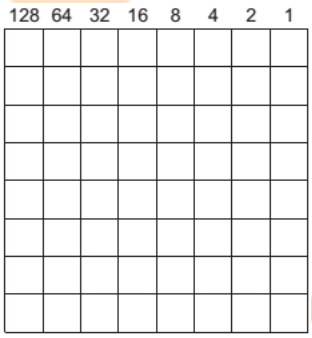
(a) What values would be stored in the table for the Greek character (Σ)?



row	value
1	
2	
3	
4	
5	
6	
7	
8	

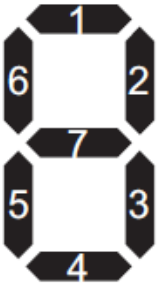
(b) Draw the character formed from the following value table:

row	value
1	146
2	146
3	84
4	84
5	56
6	16
7	16
8	16



Q 27) Summer 2007 P1

A 7-segment display is used to indicate which floor a lift is on. Each segment is numbered as shown:



A byte is used to hold the data needed to light the correct segments. Bit 0 is always zero.

For example, 3 is represented by

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and by

1	0	0	1	1	1	1	0
7	6	5	4	3	2	1	0

Bit Number

(a) If the lift is to stop at more than one floor, the data is held in successive bytes. For example:

FIRST BYTE:	0	0	0	0	1	1	1	0
SECOND BYTE:	1	1	0	1	1	0	1	0

Which floor numbers are stored in each byte?

First byte floor number ..... [1]

Second byte floor number ..... [1]

(c) What bit pattern is used to indicate Floor 2?

(c) The lift is travelling down to stop at Floors 5, 3 and 1. When it stops at Floor 5, a passenger gets in and presses the button for Floor 2.

How does the system ensure that the lift stops at Floors 3, 2 and 1 in that order?

.....

..... [3]

Q 28) Summer 2005

A microprocessor controls the washing cycle of an automatic washing machine and gives output to the following devices:

•water valve • heater • wash motor • pump

Control bits are sent to turn parts of the system on or off, i.e. 1 is on and 0 is of

8	7	6	5	4	3	2	1
0	1	1	0	0	0	0	0

..... not in use .....

heater

pump

water valve

wash motor

(a) State what is happening when the above bit pattern is set?

.....[1]

(b) Write down the bit pattern that would be set if the water has reached the correct level, the temperature is the required temperature, the clothes have been washed and the pump is now pumping the water out of the machine.

8	7	6	5	4	3	2	1

(c) State **one** other process that the microprocessor could control.

..... [1]

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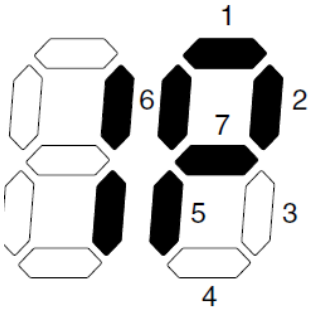
Q 29) Winter 2003

Two 7 segment displays are used on a car dashboard to give information to the driver. Each segment is numbered as shown.



(1) (2)

For example, the information **1P** shown above is represented by:

	7	6	5	4	3	2	1	0
(1)	0	0	0	0	1	1	0	0

and by:

(2)	1	1	1	0	0	1	1	0

Bit 0 is always zero

(a) What is being displayed to the driver if bytes (1) and (2) are showing?

(1)	1	1	0	0	1	1	0	0

(2)	1	1	1	0	0	0	1	0

(b) What bit patterns must be used to show the information **0L**?

(0)								

(L)								

(c) Most of the other information on the dashboard is in analogue form.

(i) State **one** advantage of displaying information in analogue form.

.....

..... [1]

(ii) State **one** disadvantage of displaying information in analogue form.

.....

..... [1]

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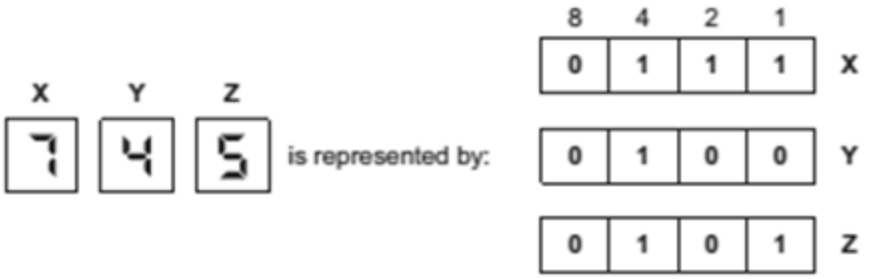
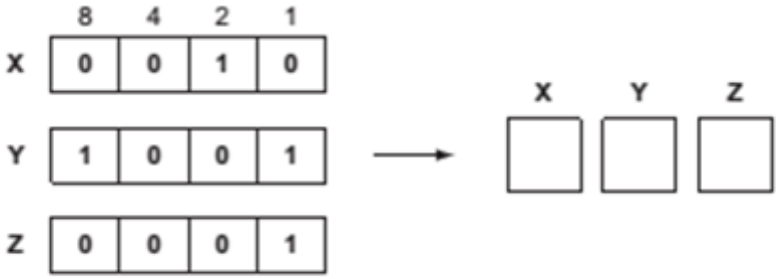
Q 30)

A digital light meter has a 3-digit LED. The value of each digit on the instrument display is stored as a 4-bit binary register.

For example:

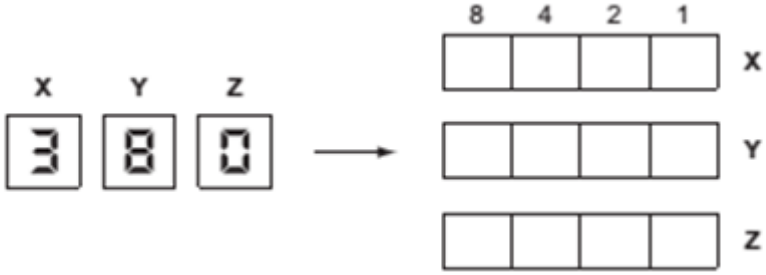


(a) What is shown on the display if the 4-bit binary registers contain?



[3]

(b) What would be stored in the 4-bit binary registers if display shows?



[3]

(d) If any one of the 4-bit binary register X, Y or Z contain the value 1 1 1 1 this indicates an error.

(i) How could this error be shown on the instrument display?

…….. [1]

(ii) What could cause an error to occur?

……

…….. [1]

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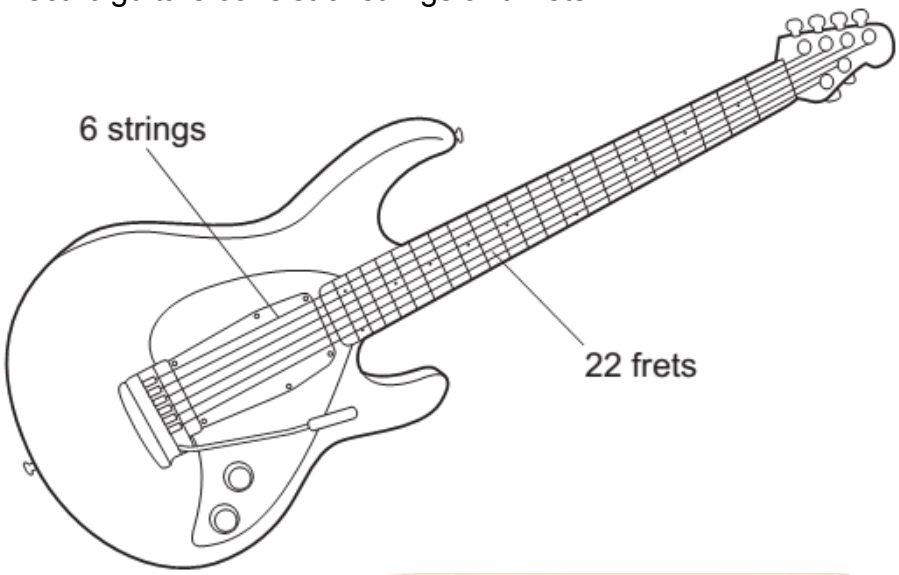
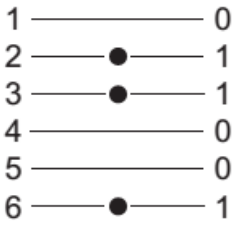
Q 31)

Electric guitars consist of strings and frets.



Musical notes on the guitar can be represented using the TAB notation:



Each line represents a string; the dots indicate which strings must be held down with the fingers. These are shown with a binary value of 1; otherwise the binary value is 0.

Thus, the above note would be shown as:

6	5	4	3	2	1
1	0	0	1	1	0

TAB notation

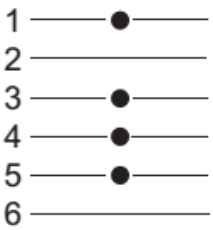
It is also important to indicate where the strings should be held down. This is shown on the
FRET. If the fingers are to be held down at the 20th FRET, this is shown in binary as:

32	16	8	4	2	1
0	1	0	1	0	0

FRET position

(NOTE: add up the numbers in the headings where binary 1s appear, i.e. 16 + 4 = 20)

(a) A note is being played according to the TAB notation:



The strings are being held down on the 18th FRET.

Write down the binary notation for the TAB and for the FRET position: [2]

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TAB notation:	6	5	4	3	2	1

FRET position:	32	16	8	4	2	1

(b) (i) Show on the diagram below which note corresponds to TAB notation: 000010.

1
2
3
4
5
6

(ii) What FRET position corresponds to 010011?

[2]

(c) Describe two advantages of storing musical notes in this format.

1
2 [2]

Q 32) Summer 2012. P11

2. A vending machine has the choices shown below.

10	tea	11	with milk	12	with sugar	13	with milk and sugar
20	coffee	21	with milk	22	with sugar	23	with milk and sugar
30	hot chocolate	31	extra milk	32	extra sugar	33	with extra milk and extra sugar
40	cold water	41	hot water	42	fizzy water		
50	coke	51	orange	52	lemon		
60	chicken soup	61	tomato soup				

A customer uses a keypad to make their choice. Each number entered is represented in a 6-bit binary register. For example, key press 33 (hot chocolate with extra milk and extra sugar) is represented by:

1	**0**	**0**	**0**	**0**	**1**
32	16	8	4	2	1

(a) (i) If a customer chooses coffee with milk and sugar what is the key press?

(ii) How is it represented in the 6-bit register?

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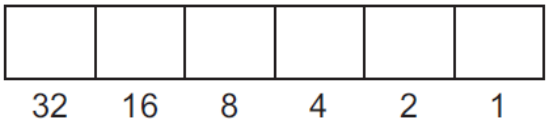
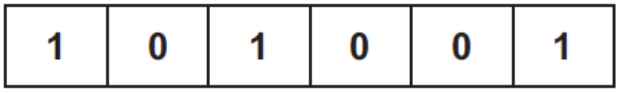


(b) If the 6-bit register shows



What drink has the customer chosen?

.....

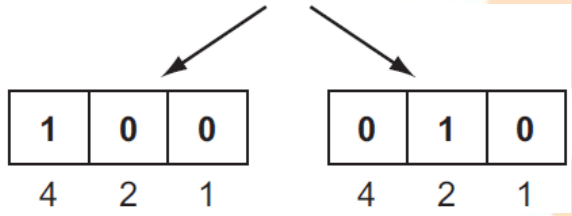
(c) A customer using the vending machine gets an error message after keying in their selection. What could have caused this error message?

.....

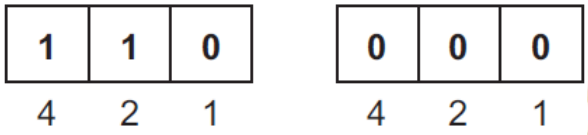
.....

(d) It was decided to split the register so that each digit was represented by its own 3-bit register: For example, would now be represented as:

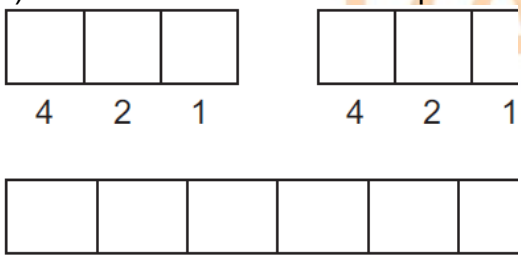
4 2



(i) What drink has been chosen if the 3-bit registers contain:



(ii) How would the lemon option be shown on both types of register?



(iii) What is the advantage of using two 3-bit registers rather than one 6-bit register?

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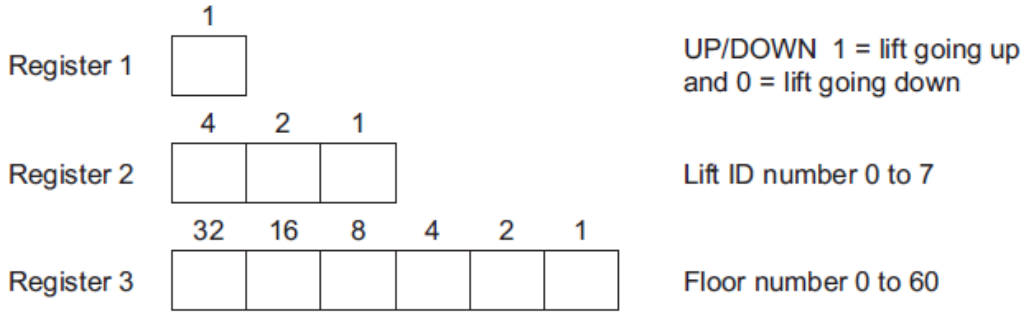
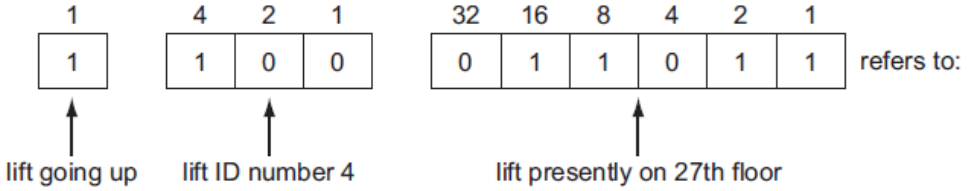
Q 33)

A large hotel uses eight lifts (elevators) to carry passengers between its sixty floors. A computer is used to control and monitor the lifts. Each lift has three registers to represent its state

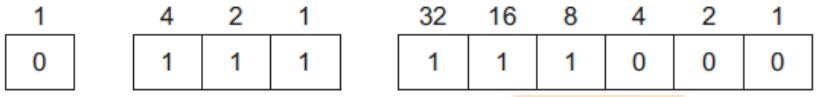


.

Thus

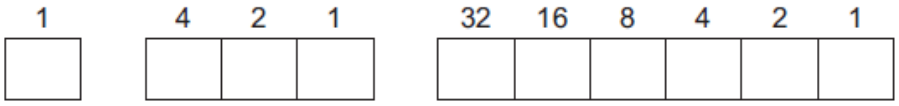


(a) If the three registers contain the following data:



What information about the lift is shown? [2]

(b) How would the following information is shown in the three registers:
lift 6 presently on the 45th floor and going down



[2]

(c) (i) A customer is on the 14th floor and wants to go to the 50th floor. She presses the button to call the lift. What two pieces of information would the computer check to identify which of the eight lifts should be made available? [2]

(ii) Using your answers to part (i), which of the following lifts would be made available to the customer?

1	0 0 0	1 0 0 1 0 0	A
0	0 0 1	0 0 1 1 1 1	B
1	0 1 0	1 1 0 0 1 0	C
1	0 1 1	0 0 1 0 1 0	D

..... [1]

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(d) An engineer wishes to test that this computer system detects incorrect data. Describe what input the engineer might use to check that the computer can correctly identify a fault condition. [2]

Q 34) Summer 2013. P12

Some decorative lights are made up from a cluster of red, blue, green, yellow and white LEDs. Each colour is represented by a binary code:

32	16	8	4	2	1	
1	0	0	0	0	0	red
0	1	0	0	0	0	blue
0	0	1	0	0	0	green
0	0	0	1	0	0	yellow
0	0	0	0	1	0	white
0	0	0	0	0	1	black (all lights off)

A 6-bit register, R1, stores the 1-values to represent a sequence of colours.
Thus, if R1 contains:

0	1	0	1	0	1

This means the blue, yellow and black colour sequence is stored and displayed in that order. The length of time each light is on is set by a binary value in another register, R2:
Thus

0	1	0

Means each colour is on for 2 seconds.
(a) The two registers contain the following values.
What is the sequence of coloured lights and the timing for each colour?

R1

0	1	1	0	1	0

R2

1	1	1

Sequence of colours timing
[2]

(b) What will the two registers contain if the coloured light sequence is red, green and black and the timing is 5 seconds?

R1

R2

[2]

(c) What is the problem with trying to display green, blue, red in that order? [2]

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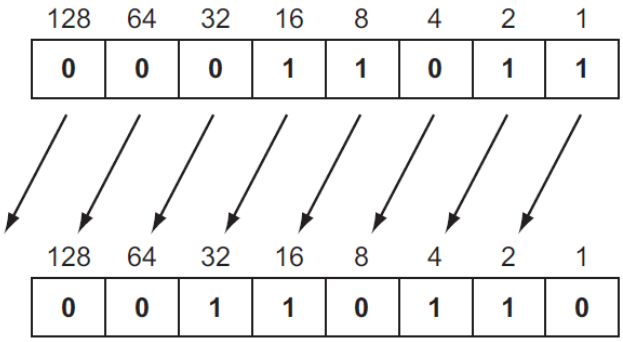
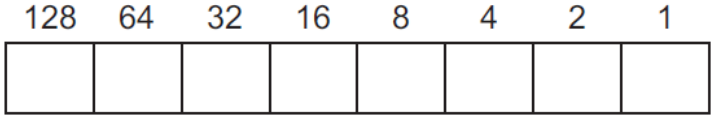
Q 35) Winter2013. P12

A denary number can be represented as an 8-bit binary number.
For example: 27 would be represented as:



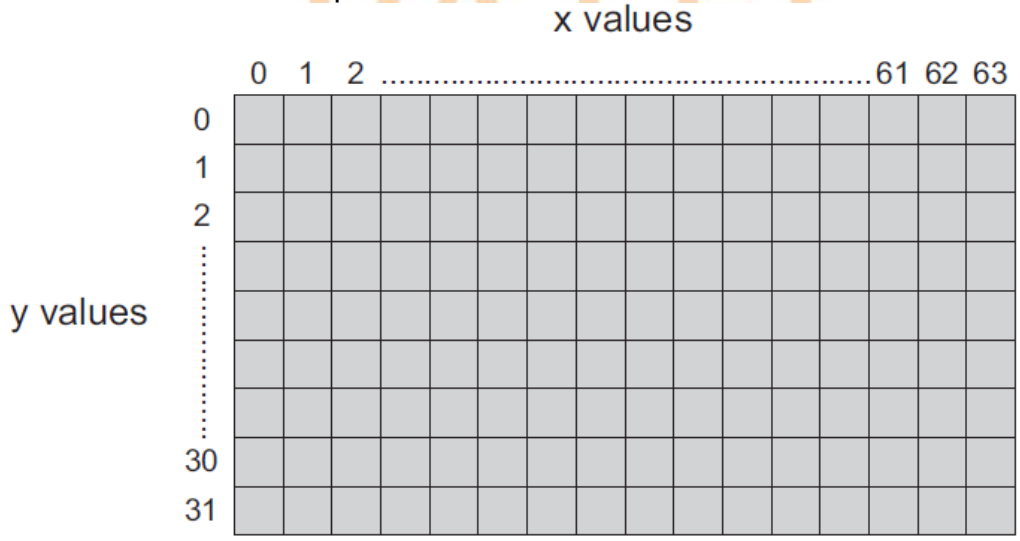
All the bits in the binary number have now been shifted (moved) one place to the left.
(a) What denary number does this now represent? [1]
(b) What effect did the shift have on the original denary number? [1]
(c) If the above binary number was shifted another one place to the left, what denary number would it be equivalent to? [1]
(d) (i) Represent the denary number 46 as an 8-bit binary number. [1]



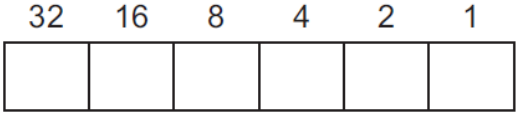
(ii) Shift this 8-bit binary number 2 places to the left.
What is the denary equivalent? [1]
(iii) What problem would arise if you tried to shift this 8-bit binary number 3 places to the left? [1]
(e) If any 8-bit binary number was shifted one place to the right, what would this be equivalent to? [1]

Q 36) Winter 2013. P13

A touch screen is divided up into a number of locations:



Each x-position is shown in a 6-bit register:



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and each y-position is shown in a 5-bit register:

16	8	4	2	1

Thus,

32	16	8	4	2	1
0	1	1	1	1	0

16	8	4	2	1
1	0	1	0	1

refers to screen position: (30, 21)

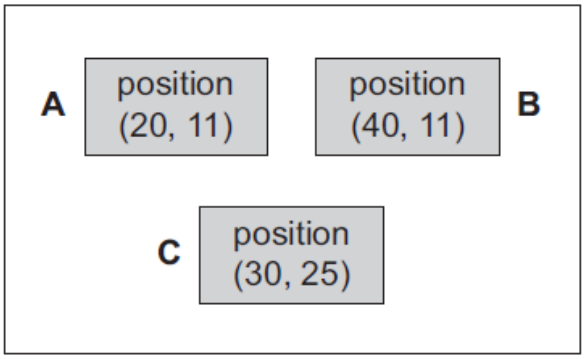
(a) Give the screen position referred to if the two registers contain:

32	16	8	4	2	1
1	1	0	1	0	0

16	8	4	2	1
0	1	1	1	0

(.....,.....)

(b) Three options (A, B, C) are shown on the touch screen below:



If the two registers contain:

32	16	8	4	2	1
1	0	1	0	0	0

16	8	4	2	1
0	1	0	1	1

what option (A, B or C) has been chosen?

.....

(c) Each box A, B, C is made up of 128 x 64 pixels.

(i) What is meant by the term pixel?

.....

(ii) The value of each pixel is stored in 1 byte of memory.
How much memory is needed to store one of these boxes?
Give your answer in kilobytes.

.....

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Q 37) Summer 2014. P12

An encryption system gives each letter of the alphabet a value:
A = 1, B = 2, C = 3, …… , Y = 25, Z = 26.
Each letter is stored in a 12-bit binary register. The letter "S" (19th letter) is stored as:

2048	1024	512	256	128	64	32	16	8	4	2	1
0	0	0	0	0	0	0	**1**	**0**	**0**	**1**	**1**

A 4-bit register is used to store the encryption key. This register shows how many places the bits are shifted to the left in the 12-bit register when it is encrypted. So,

8	4	2	1
0	**1**	**0**	**1**

means each bit in the 12-bit register is shifted 5 places to the left and the register now becomes:

2048	1024	512	256	128	64	32	16	8	4	2	1
0	0	**1**	**0**	**0**	**1**	**1**	0	0	0	0	0

Therefore, the letter "S" would be transmitted with the 4-bit register and the 12-bit register as follows:

0	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**

(a) "W" is the 23rd letter of the alphabet.
(i) Show how this letter would be stored in the 12-bit register before encryption:

(ii) The 4-bit register contains the following value:

8	4	2	1
0	**1**	**1**	**0**

Show how the letter "W" is now stored in the 12-bit register in encrypted form:

(b) Find which letter of the alphabet has been encrypted here. (Show all your working.)

0	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**0**

(c) (i) What is the largest encryption key that can be stored in the 4-bit register?

8	4	2	1

(ii) Convert this into denary (base 10).
(iii) If this encryption key were used, what problem would it cause? [3]

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Marking Schemes

Q1) ● (A member of the) character set that a computer recognises
● character on a standard keyboard
● standard to many machines
● stored in binary as . . .
● 7, 8 or 9 bits per character

Q2 C)
– easier to identify values
– easier to spot errors
– it is 4 bits per hex digit / straightforward to convert
– Shorter number to remember/quicker to enter/less susceptible to e rror.

*Q6)**(a)** Each character is given a numeric code•*
Including symbols, digits, upper and lower case•
This code is then stored in binary•
Each character takes 1 byte•
Text is stored as a series of bytes (1 per character)•
*Some codes are reserved for control characters (e.g. TAB, Carriage Return)**[3]***
(b)** All the characters which are recognised/can be represented by the computer system**[1]
***(c)** Unicode has a much larger character set•*
... and can represent many more•
characters/characters from all alphabets
Because Unicode uses 16 bits...•
... and ASCII uses fewer/7/8 bits•
*Q8) **(a) (i)** • 64 + 32 + 8 + 1=• 105.*
***(ii)** Answer: 10011010*
(one mark per nibble if partly wrong)
***(b) (i)** Answer: 9 7 B (one mark per hex digit)*
(ii)• it is 4 bits per hex digit / straightforward to convert
• shorter number to remember/quicker to enter/less susceptible to error.
*Q10)**(a)** Circuit only needs to check for two states/uses switches*
… electricity flowing or not flowing/on or off/1 and 0
... resulting in more reliable circuits.

***(b) (i)** Each character is assigned a unique character code, Each letter is converted to its character code (which is a binary number)*
***(ii)** 0100 0011 0100 0001 0100 0010. Correct answer only but spaces don't matter*
***(iii)** ASCII uses 8 bits...*
... and so can only represent 255/256 distinct characters...
..many more characters are needed for coping with all languages (e.g. Unicode 16bits).
ASCII does contain characters used in some languages

Q24) (a) 1 mark for hours; 1 mark for minutes
1 6 : 4 9
1 mark 1 mark [2]
(b) 1 mark for each digit
0 0 0 1 1st digit
0 1 1 1 2nd digit
0 0 1 0 3rd digit
1 0 0 1 4th digit [4]
(c) Any two from:
– microprocessor compares present time with stored time
– if the values are the same
– sends signal to sound alarm [2]

Q27) (c) Any three points from:
Notes lift is going down
Notes required floor is less than present floor
Sorts remaining numbers into descending order of floors [3]

Q28) (c) Any one from:
release door – via door switch
releasing powder at set intervals/fabric conditioner
drying/spinning
give error messages/beeps
stored programs for different washes e.g. cottons/woolens [1]

Q29) (c) (i) any one from:
drivers used to analogue instruments
readings are steadier
more accurate (because of infinite number of positions)

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easier to see "trends" in read outs/easier to understand [1]
(ii) any one from:
not as easy to read as digital
needs to be interpreted by user
mechanical device more likely to break down/fail [1]
Q30)(i) E, E, E
Flashing display/digits
ERR
(or the equivalent answer) [1]
(ii) Any one from:
– a fault in the system
– reading exceeded the value 999 [1]
Q37) c(iii) – try to move 15 places to the left which is not possible
– only 12 bits in register to store letter; 15 is too large
– you would end up with 12 0s in the register [3]

PATEL

1.2 Communication and Internet technologies

1.2.1 Serial and parallel data transmission
• show understanding of what is meant by transmission of data
• distinguish between serial and parallel data transmission
• show understanding of the reasons for choosing serial or parallel data transmission
• show understanding of the need to check for errors
• explain how parity bits are used for error detection
• identify current uses of serial and parallel data transmission, such as Integrated Circuits (IC) and Universal Serial Bus (USB)
1.2.2 Security aspects
• show understanding of the security aspects of using the Internet and understand what methods are available to help minimise the risks
• show understanding of the Internet risks associated with malware, including viruses, spyware and hacking
• explain how anti-virus and other protection software helps to protect the user from security risks
(this also links into section 1.4 of the syllabus)
1.2.3 Internet principles of operation
• show understanding of the role of the browser and Internet server
• show understanding of what is meant by hypertext transfer protocol (http) and HTML
• distinguish between HTML structure and presentation
• show understanding of the concept of MAC address, Internet Protocol (IP) address and cookies

All the systems that have been mentioned so far have been stand-alone computers. This means that the systems we have discussed so far are not connected to other machines. Consider a classroom with 20 stand-alone computers. Every time a lesson ends, you need to store your files on secondary storage. It would be possible to store the files on a USB stick and take them away with you, but the likelihood is that the files are stored on the hard disk. The next time you want to use those files, you need to sit at the same computer. It would be much more sensible to have a system that allowed access to the same files through any of the 20 computers. To allow for this, the computers need to be connected to each other so that you can store your files on a shared disk drive. When computers are connected together to share files, they form a network.

Generally, a network over short distances is called a **local area network (LAN)** while those over great distances are **wide area networks (WAN)**. Whether a network is a WAN or a LAN, it allows the computers to:

- communicate with one another
- share information centrally
- share copies of software
- give access to data and program files to multiple user

In a LAN there is the added benefit of being able to share hardware. For example, the classroom with 20 computers may only have one or two printers. Also, those printers

may be of different types and used for different tasks. This means that the type of printer used is dependent on the job that the user wants it to do rather than on the type of printer that happens to be connected to the computer from which the printout is sent.

To summaries:

A network is defined as a collection of computers and peripheral devices (such as printers) connected together.

A local area network (LAN) is a network that interconnects computers in a limited area such as a home, school, computer laboratory, or office building.

The connections can be cable, fibre-optic, or wireless (infra-red, microwave or radio).

Advantages of networks

Sharing resources:•

o Sharing folders and files so you can access them anywhere on the network from any computer

o Sharing peripheral devices such as printers and scanners

o Sharing an internet connection

Communication:•

o Using email to communicate with colleagues

o Using messaging systems to chat while you are working on other things

o Transferring files between computers

Centralised management:•

o User profiles and security can all be managed centrally

o Software can be distributed across the network rather than having to install it on

o each individual computer

o Users can use any PC on the network but still see their own files

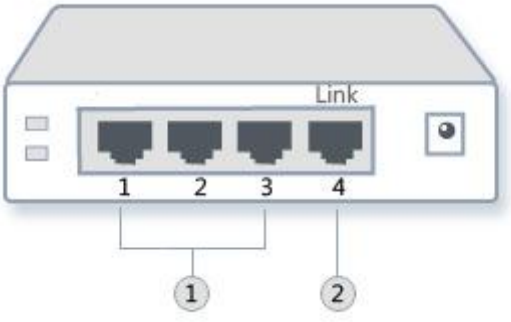
o Data can easily be backed up centrally.

Hardware requirements

There are several kinds of hardware used in home networks:

- Network adapters. These adapters (also called network interface cards or NICs) connect computers to a network so that they can communicate. A network adapter can be connected to the USB or Ethernet port on your computer or installed inside your computer in an available Peripheral Component Interconnect (PCI) expansion slot.

- Network hubs and switches. Hubs and switches connect two or more computers to an Ethernet network.



1 Ports for computers

2 Port for connecting to a router, another hub, or a switch (typically labeled "Link" or "Out")

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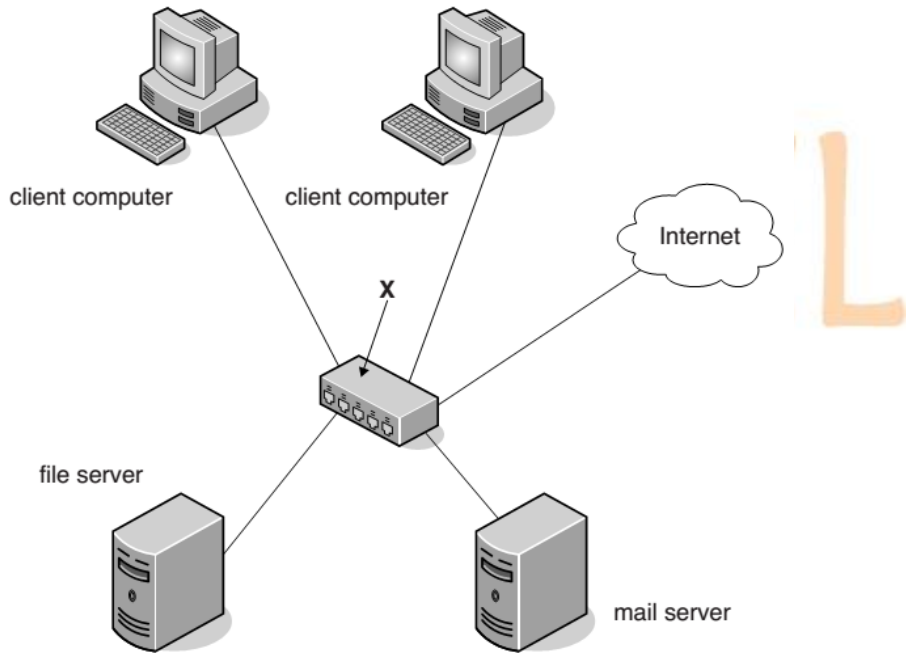
A switch costs a little more than a hub, but it's faster.

- Routers and access points. Routers connect computers and networks to each other (for example, a router can connect your home network to the Internet). Routers also enable you to share a single Internet connection among several computers. Routers can be wired or wireless. You don't need to use a router for a wired network but we recommend it if you want to share an Internet connection. If you want to share an Internet connection over a wireless network, you will need a wireless router. Access points allow computers and devices to connect to a wireless network.
- Modems. Computers use modems to send and receive information over telephone or cable lines. You will need a modem if you want to connect to the Internet. Some cable providers supply a cable modem—either free or for purchase—when you order cable Internet service. Modem-and-router combination devices are also available.
- Network cables (Ethernet, HomePNA, and Powerline). Network cables connect computers to each other and to other related hardware, such as hubs, routers, and external network adapters. HomePNA and Powerline adapters are often external and connect to a computer with either Ethernet cables or USB cables, depending on the type of adapter.

Example Question 1:

The diagram shows a computer network with connection to the Internet.



Name the hardware device labelled **X**.

.....[1]

1.2.1 Data Transmission

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Information flows through the computer in many ways. The CPU is the central point for most information. When you start a program, the CPU instructs the storage device to load the program into RAM. When you create data and print it, the CPU instructs the printer to output the data.

Because of the different types of devices that send and receive information, two major types of data transfers take place within a computer: parallel and serial.

Parallel transmission of data

Parallel transfers use multiple "lanes" for data and programs, and in keeping with the 8 bits = 1 byte nature of computer information, most parallel transfers use multiples of 8. Parallel transfers take place between the following devices:

- CPU and RAM
- CPU and interface cards (see Chapter 8)
- **LPT** (printer) port and parallel printer
- **SCSI** port and SCSI devices
- **ATA/IDE** host adapter and ATA/IDE drives
- RAM and interface cards (either via the CPU or directly with DMA)

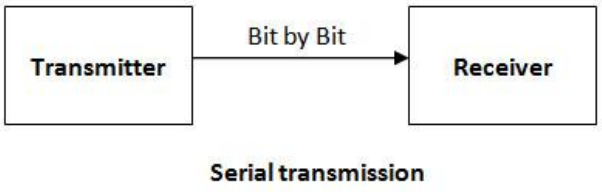
Parallel cable

Why are parallel transfers so popular?

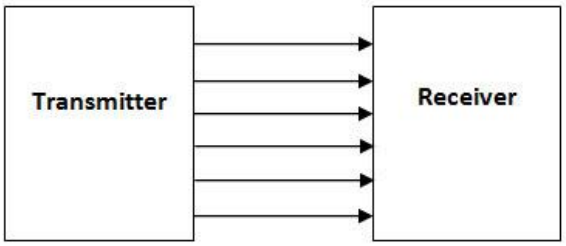
- Multiple bits of information are sent at the same time.
- At identical clock speeds, parallel transfers are faster than serial transfers because more data is being transferred.

However, parallel transfers also have problems:

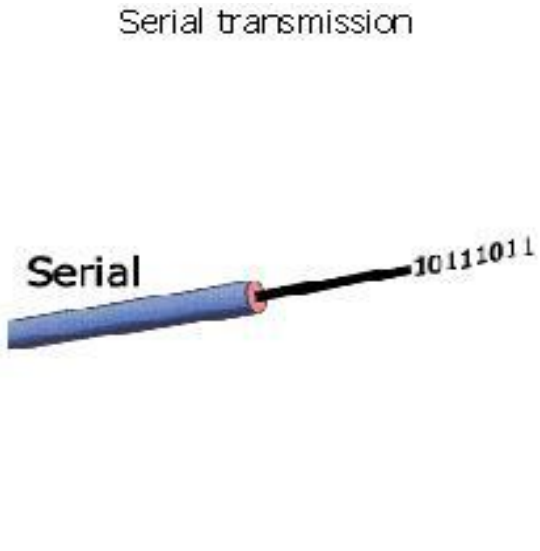
- Many wires or traces (wire-like connections on the motherboard or expansion cards) are needed, leading to interference concerns and thick, expensive cables.
- Excessively long parallel cables or traces can cause data to arrive at different times. This is referred to as *signal skew*



Serial transmission



Parallel transmission



Serial data transmission

A **serial** transfer uses a single "lane" in the computer for information transfers. This sounds like a recipe for slowdowns, but it all depends on how fast the speed limit is on the "data highway."

Serial transmission has the advantage of being simple and reliable because the next bit is not transmitted until the current one has been received.

The following ports and devices in the computer use serial transfers:

- Serial ports and devices
- **USB** (Universal Serial Bus) ports and devices
- Modems (which can be internal devices or can connect to serial or USB ports)
- **Serial ATA** (SATA) host adapters and drives

Serial transfers have the following characteristics:

- One bit at a time is transferred to the device.
- Transmission speeds can vary greatly, depending on the sender and receiver.
- Very few connections are needed in the cable and ports (one transmit, one receive, and a few control and ground wires).
- Cable lengths can be longer with serial devices. For example, an UltraDMA/66 ATA/IDE cable can be only 18 inches long for reliable data transmission, whereas a Serial ATA cable can be almost twice as long.

Serial transmission is between two computers or from a computer to an external device located some distance away.

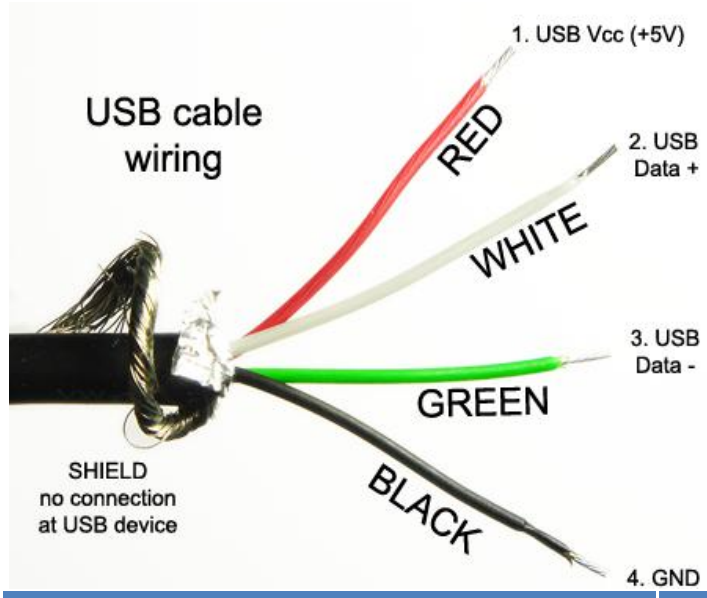
USB (Universal Serial Bus):

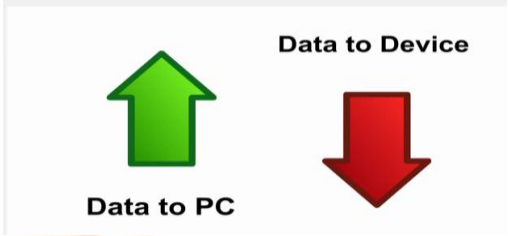
Universal Serial Bus (USB) is a plug-and-play interface that allows a computer to communicate with peripheral and other devices.

- It is a BUS as it has wires to transmit data.
- It is UNIVERSAL as it connects devices cover a broad range; anything from keyboards and mice, to music players and flash drives.
- It is SERIAL as in USB data is transmitted bit by bit. USB has 4 cables of which 2 are used for power supply (0V and 5V), 1 to send data from PC to peripheral and 1 to receive data from peripheral.

USB may also be used to send power to certain devices, such as smart phones and tablets, as well as charge their batteries.

The Universal Serial Bus industry standard was established in 1995, and then quickly adopted by companies.





Advantages	Disadvantages
Devices plugged into the computer are automatically detected; device drivers are automatically uploaded	
The connectors can only fit one way; this prevents incorrect connections being made	The maximum cable length is presently about 5 meters
This has become the industry standard; this means that considerable support is available to users	
Several different data transmission rates are supported	The present transmission rate is limited to less than 500 megabits per second
Newer USB standards are backward compatible with older USB standards	The older USB standard (e.g. 1.1) may not be supported in the near future

Synchronous Communication:

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Synchronous means:

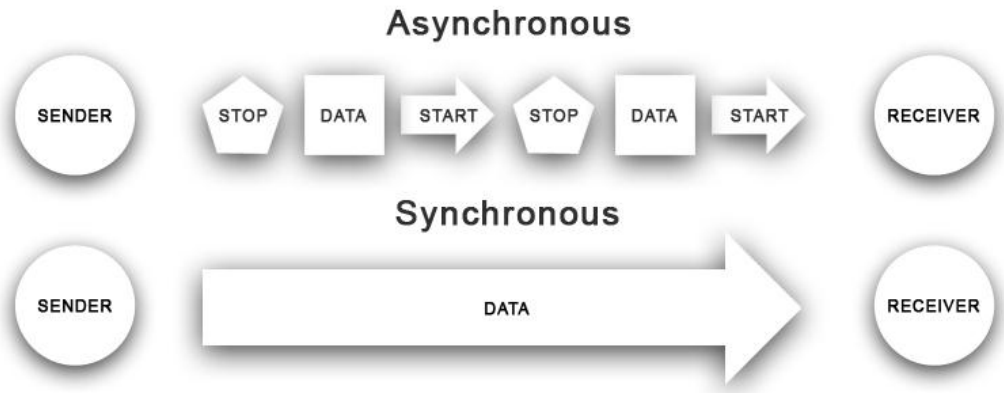
a. Occurring at the same time; coinciding in time; simultaneous.
b. going on at the same rate and exactly together; recurring together

Synchronous transmission sends data as one long bit stream or block of data. There are no gaps in transmission; each bit is sent one after the other. The receiver counts the bits and reconstructs bytes. It is essential that timing is maintained as there are no start and stop bits and no gaps. Accuracy is dependent on the receiver keeping an accurate count of the bits as they come in.

Synchronous transmission is faster than asynchronous because fewer bits have to be transmitted; i.e: only data bits and no extra control bits. For this reason it is the choice for network communications links.

Chat rooms and online conferences are good examples of synchronous communication.

Asynchronous Communication:
With **asynchronous transmission** signal timing is not required; signals are sent in an agreed pattern of bits and if both ends are agreed on the pattern then communication can take place.
Asynchronous transmission is relatively slow due to the increased number of bits and gaps. It is a cheap and effective form of serial transmission and is particularly suited for low speed connections such as keyboard and mouse.
Discussion forums and email are two examples of how asynchronous communication



Advantages and disadvantages

	Advantages	**Disadvantages**
Asynchronous transmission	• Simple, doesn't require synchronization of both communication sides • Cheap, because asynchronous transmission requires less hardware • Setup is faster than other transmissions, so well suited for applications where messages are generated at irregular intervals, for example data entry from the	• Large relative overhead, a high proportion of the transmitted bits are uniquely for control purposes and thus carry no useful information

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	keyboard, and the speed depends on different applications.	
Synchronous transmission	• Lower overhead and thus, greater throughput	• Slightly more complex • Hardware is more expensive

Errors in data transmission

When data, of whatever type, are transmitted from one device to another, they are transmitted as a series of binary digits. Any data that are transmitted are going to be made up of a very large number of bits. Consequently, there are bound to be occasions on which the data are not transmitted correctly or on which they become corrupted during transmission.

There are only two possible types of error that can occur; either a 1 is received as a 0 or a 0 is received as a 1. Mistakes rarely occur, but when they do occur they can be very serious, as the data are no longer correct. This makes it important that there should be methods for checking the data when they are transmitted.

Echoing back

The simplest way of checking the transfer of the data is to send the data back again. If the data sent back are the same as the data sent in the first place then the original data must have reached the destination unaltered. If not, the data must be sent again. This is known as echoing back. Echoing back is very effective, but suffers from having to send data twice. The transmission mode needs to be either duplex or half duplex to allow data transfer in both directions.

Checksum

Data are normally sent as blocks of bytes rather than as individual bytes. Whatever the data represent, they are in binary form and hence could be treated as numbers that can be added together. Another checking procedure is to add all the bytes that are being sent in the block of data. Any bits lost at the most-significant end as a carry are ignored, so the answer is an eight-bit number. This “check byte” or **checksum** is calculated before the data are sent and then calculated again when they are received. If there are no errors in the transmission, the two answers match. If, however, the two bytes are different there must be at least one checksum that has been corrupted and the whole block of data has to be re-sent.

Parity check

A **parity check** involves checking that the number of 1 bits in a byte totals to an even number (called “even parity”) or an odd number (called “odd parity”). If two devices that are communicating decide to use odd parity, there must always be an odd number of 1s. If a byte is received with an even number of 1s, an error must have occurred. For example, the byte 01011000 is sent. It has three 1 bits so it passes the odd parity check. When it is transmitted, the byte received is 11011000. This has four 1 bits, which is an even number, so there must have been an error in transmission. The receiving device would ask for it to be sent again. Although this example uses odd parity, even parity can equally well be used. The two devices have to agree which type of parity to use.

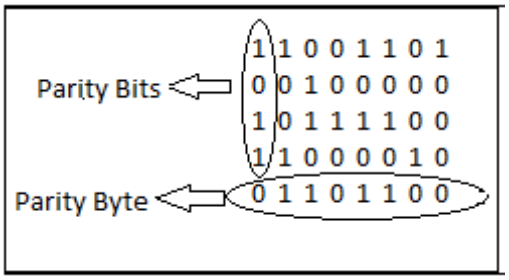
Parity is used not only during data transfer between devices but also when data are transferred between different components of the CPU. If two mistakes are made in the same byte, they cancel each other out and the faulty data are accepted.
This problem can be overcome and a clever way of identifying mistakes can be implemented by using **parity blocks**.
A byte can represent a character code in eight bits, giving potentially 256 different characters. However, an ASCII character reserves one of the bits for a parity bit. This leaves seven bits for the character code, reducing the number of different characters to 128.

Example Question 2:

What is wrong with the following statements?
a. The two checksums match so there is no error in the data file that has been transmitted.
b. Odd parity means that correct bytes are always an odd binary number.
c. 01101100 has been received using odd parity therefore it has been correctly transmitted.
There are two types of parity, odd and even. Try to think of reasons why odd parity may be preferable to using even parity.

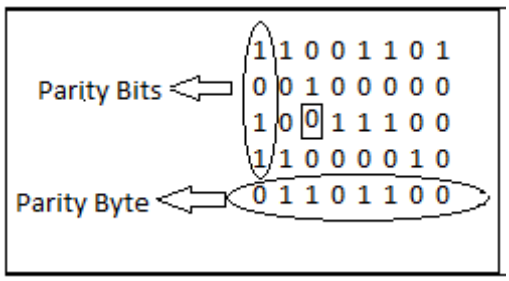
Parity blocks

A further check can be made on the data bytes which are transmitted. An additional byte, called the parity byte, is calculated and transmitted for each group of bytes. The data bytes and parity byte together are called a parity block.



A parity block is like a rectangle made up of rows and columns. The last bit in each row, i.e. in each data byte, is the parity bit, which checks if there is an error in the byte. One possible problem with a parity bit check is that two errors in the same byte are not picked up by the parity bit check. They are however detected by the check which the parity byte performs.
Think of the parity byte not as data but as a whole row of parity bits, each of which is there to check the column of bits above it in the grid. Consider the following transmission in which four data bytes are followed by the parity byte using odd parity. The correctly transmitted parity block (four data bytes followed by the parity byte) is shown in Figure.

Assume that there was an error in the transmission and the bytes shown in Figure 1.5.6 were received by the device. The parity bit for data byte three is calculated as 1. A 0 bit was received, so the conclusion is that there must be an error with it. The parity byte shows that there is an error with



the calculation in column three. The conclusion is that the incorrect bit in byte three must be the one in column 3, so change this from 0 to 1.

Consider Figure, which shows two bits received in error in the same data byte. Byte three passes the parity bit check. The point here is that the parity bit is in error! The parity byte, however, shows that there is an error – the bits in positions 4 and 8 of the parity byte do not match the calculation for columns 4 and 8.

It is claimed that checking the parity bits and using a parity block check will identify 99% of all transmission errors.

Examination Questions

Q1) Explain the difference between a wide area network (WAN) and a local area network (LAN).

.....
..... [2]

(Hint: You need to give *two* distinct points of comparison. Saying that one covers a large area and the other a local area is insufficient.)

1. a. State **three** pieces of hardware that are needed to create a LAN from a set of stand-alone computers.

1. .....
2. .....
3. ..... [3]

b. Explain why the communication over a WAN differs from that across a LAN and state how the hardware necessary for communication would differ from that used in part (a)

.....
..... [3]

Q2) Explain the difference between:

a. simplex transmission of data b. half-duplex transmission of data

c. duplex transmission of data

giving an example of the use of each. [6]

(Hint: Don't try to be imaginative – give the standard examples.)

.....
.....
.....
..... [6]

Q3) The following bytes of data are sent to a second device using even parity:

11001100
01000100
10101011
10011010

An automatic checking technique is used to check that the data has been transmitted

without error.

a. State which byte has been received incorrectly, explaining how you arrived at your answer.

.....
.....
..... [3]

b. Explain why it is possible that a byte of data could still be incorrect despite passing the test that you used in part (a).

.....
..... [1]

c. If the parity byte 10110101 had been transmitted with the data block, explain how the error could be self-checked and corrected.

.....
..... [3]

Q4) Data which is transmitted between survey sites and head office is liable to errors. Data which is received is checked for errors.

a. One method of checking for errors is to use parity checks.

The following four bytes have been received:

01101001
10111100
10101010
00100100

i. One of the bytes contains an error. State which byte.

..... [1]

ii. Explain your choice of answer in (i).

.....
..... [2]

iii. Explain why a byte may still be in error even if it passes the parity test.

..... [1]

iv. Describe how a parity block may be used to identify the location of the error if one occurs.

.....
.....
.....
..... [4]

Q5) (a) Two methods of connecting to the Internet are dial-up and broadband. Give two advantages of using broadband.

.....
.....
.....[2]

(b) Computers often use wireless (Wi-Fi) technology to connect to the Internet. Give one advantage and one disadvantage of using Wi-Fi.

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Advantage of Wi-Fi:

.....

Disadvantage of Wi-Fi:

..... [2]

(c) Apart from computers, name another device that uses Wi-Fi technology.

..... [1]

(b) Give two benefits of having computers networked together.

1 .....

2 ..... [2]

(c) Give one drawback of having computers networked together.

..... [1]

Q6 Summer 2014 P11) You have been asked to write a report on the use of the following communication methods:

• mobile phones • video conferencing • emails

Describe a benefit and a drawback of each of the above communication methods.

mobile phones

Benefit .....

Drawback .....

video conferencing

Benefit .....

Drawback .....

emails

Benefit .....

Drawback..... [6]

Q7) Most of the hotels offer wireless Internet (Wi-Fi) in the rooms.

Give two disadvantages of using wireless (Wi-Fi) rather than wired Internet access.

1 .....

2 ..... [2]

(a) Describe what is meant by:

(i) serial, simplex transmission

.....

(ii) parallel, full duplex transmission

..... [2]

(b) The word C O M P U T I N G is to be transmitted as nine bytes of data. Each character in the word has an ASCII value. The system uses even parity and the left most bit is added to make each byte even parity.

(i) Complete the codes so that they all have even parity.

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C		1	0	0	0	0	1	1
O		1	0	0	1	1	1	1
M		1	0	0	1	1	0	1
P		1	0	1	0	0	0	0
U		1	0	1	0	1	0	1
T		1	0	1	1	0	0	0
I		1	0	0	1	0	0	1
N		1	0	0	1	1	1	0
G		1	0	0	0	1	1	1

(ii) Fill in the parity byte in the final row in the table above. [1]

(iii) The character 'P' is received incorrectly as 0 1 0 1 1 0 0 0

Describe how horizontal and vertical parity checking would be used to detect the erroneous

bit. .....

.....

..... [3]

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1.2.3 Internet principles of operation

1.2.3 Internet principles of operation
• show understanding of the role of the browser and Internet server
• show understanding of what is meant by hypertext transfer protocol (http) and HTML
• distinguish between HTML structure and presentation
• show understanding of the concept of MAC address, Internet Protocol (IP) address and cookies

Web browser

Short for *Web browser,* a software application used to locate, retrieve and also display content on the World Wide Web, including Web pages, images, video and other files. As a client/server model, the browser is the client run on a computer that contacts the Web server and requests information. The Web server sends the information back to the Web browser which displays the results on the computer or other Internet-enabled device that supports a browser.

An *information resource* is identified by a Uniform Resource Identifier (URI/URL) and may be a web page, image, video or other piece of content. Hyperlinks present in resources enable users easily to navigate their browsers to related resources.

Although browsers are primarily intended to use the World Wide Web, they can also be used to access information provided by web servers in private networks or files in file systems.

The major web browsers are Google Chrome, Mozilla Firefox, Internet Explorer, Opera, and Safari.

Internet Server

Internet server (web server) is a special computer, on which websites are stored. Web Server is constantly switched on and connected to the Internet so that each Internet user around the world can access website at all times. This computer is built up with selected high quality components, which can endure incessant work and high load.

Internet **servers** make the Internet possible. All of the machines on the Internet are either servers or **clients**. The machines that provide services to other machines are servers. And the machines that are used to connect to those services are clients. There are Web servers, e-mail servers, FTP servers and so on serving the needs of Internet users all over the world.

When you connect to www.ruknuddin.com to read a page, you are a user sitting at a client's machine. You are accessing the Ruknuddin Web server. The server machine finds the page you requested and sends it to you. Clients that come to a server machine do so with a specific intent, so clients direct their requests to a specific software server running on the server machine. For example, if you are running a Web browser on your machine, it will want to talk to the Web server on the server machine, not the e-mail server.

A server has a static IP address that does not change very often. A home machine that is dialing up through a modem, on the other hand, typically has an IP address assigned by the ISP every time you dial in. That IP address is unique for your session -- it may be

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different the next time you dial in. This way, an ISP only needs one IP address for each modem it supports, rather than one for each customer.

HTTP

Short for ***H**yper**T**ext**T**ransfer**P**rotocol*, the underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands. For example, when you enter a URL in your browser, this actually sends an HTTP command to the Web server directing it to fetch and transmit the requested Web page.

HTML

HTML (***H**yper**T**ext**M**arkup**L**anguage)* is an authoring language used to create documents to be viewed on the World Wide Web.

HTML is similar to SGML, although it is not a strict subset.

HTML defines the structure and layout of a Web document by using a variety of tags and attributes. The correct structure for an HTML document starts with <HTML><HEAD> (enter here what document is about) <BODY> and ends with </BODY></HTML>. All the information you'd like to include in your Web page fits in between the <BODY> and </BODY> tags.

There are hundreds of other tags used to format and layout the information in a Web page. Tags are also used to specify hypertext links. These allow Web developers to direct users to other Web pages with only a click of the mouse on either an image or word(s). For a more complete list of tags, check out some of the URLs below.

IP Addressing

An Internet Protocol (IP) address is a unique 32-bit reference number that is allocated to devices on a computer network that uses the Internet Protocol.

Although IP addresses are stored as 32-bit numbers, for our convenience they are usually displayed as a series of 4 decimal numbers, each one representing 8 bits of the original binary address.

32-bit binary version: 11001001101000001011011011111111

Decimal version: 201.64.182.255

Some IP addresses are reserved for private network ranges e.g.

10.0.0.0 - 10.255.255.255

172.16.0.0 - 172.31.255.255

192.168.0.0 - 192.168.255.255

IPv4

IPv4 is the most widely deployed Internet protocol used to connect devices to the Internet. IPv4 uses a 32-bitaddress scheme allowing for a total of 2^32 addresses (just over 4 billion addresses). With the growth of the Internet it is expected that the number of unused IPv4 addresses will eventually run out because every device -- including computers, smart phones and game consoles -- that connects to the Internet requires an address.

IPv6

IPv6 addresses are 128-bit IP address for a total of 3.4x10^38 computers.
IPv6 is written in hexadecimal and separated by colons.
An example IPv6 address could be written like this: **3ffe:1900:4545:3:200:f8ff:fe21:67cf**

Example Question 1:

The table shows four statements about IP addresses.
Tick (✓) to show which of the statements are true.

Statement	True (✓)
The IP address consists of any number of digits separated by single dots (.)	
Each number in an IP address can range from 0 to 255	
IP addresses are used to ensure that messages and data reach their correct destinations	
Public IP addresses are considered to be more secure than private IP addresses	

MAC Addressing

In computer networking, a Media Access Control address (MAC address) is a unique 48-bit number assigned to a network interface card (NIC) to identify it on a LAN. Because they are so long, MAC addresses are usually displayed in hexadecimal.
48-bit binary version: 000000000000100101111100111100011111011110000101
Hexadecimal version: 00-09-7C-F1-F7-85
MAC addresses are limited to being used on a LAN while IP addresses can be used on multiple types of networks including the Internet.
On a LAN, data packets that use a protocol such as TCP/IP will be packaged inside data packets that use the MAC address to deliver them correctly.
Another use for the MAC address is as a security feature on cable and wireless systems, only allowing computers with authorised MAC addresses to have access to the network. This works by inspecting the data packet that is sent from a computer to see if its MAC address matches one of the approved ones in a pre-defined table.

Uniform Resource Locator (URL):

URL stands for Uniform Resource Locator. It is the address of a web page. Each page has its own unique web address (URL).
This is how a computer locates the web page that user is trying to find.
An example of a URL is: http://ruknuddin.com/computer2210.html.
In this example

- "http" enables browser to know what protocol is being used to access information in the domain
- "ruknuddin.com" is called the domain name.
- "computer2210.html" refers to the specific page.

URL encoding:

Web addresses can be written using hexadecimal rather than denary. Hexadecimal codes are preceded by a % sign. For example, the word "**www.ruknuddin.com"** is written as:

	r	u	k	n	u	d	d	i	n
in hex	%72	%75	%6B	%6E	%75	%64	%64	%69	%6E

w	w	w	.	r	u	k	n	u	d	d	i	n	.	c	o	m
%77	%77	%77	%2E	%72	%75	%6B	%6E	%75	%64	%64	%69	%6E	%2E	%63	%6F	%6D

Some characters are not allowed in URL. URL encoding converts characters into a format that can be transmitted over the Internet.

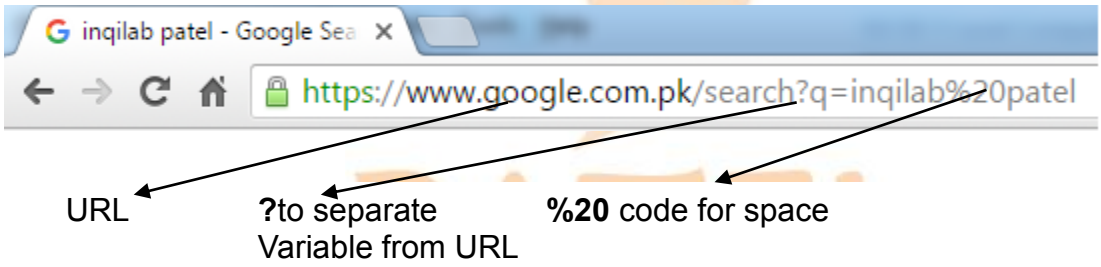
For example

- %20 – is used in URL in place of <space> not allowed in a URL, %20 is the coding for a space (32 in denary)
- ? – separates the URL from all parameters or variables
  e.g. for query to search inqilabpatel in Google

https://www.google.com.pk/search?q=inqilab%20patel

here **"q"** is variable for query "**?**" separates it from URL **"https://www.google.com.pk/search"**

while**"%20"** is used for the space between **"inqilab" and "patel"**



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Example Question 2:

Consider the URL:

http://cie.org.uk/computerscience.html

(i) Give the meaning of the following parts of the URL.

http .....
.....
.....
cie.org.uk .....
.....
.....
computerscience.html .....
.....
..... [3]

(ii) Sometimes the URL contains the characters **%20** and **?**.
Describe the function of these characters.

%20 .....
.....
? .....
..... [2]

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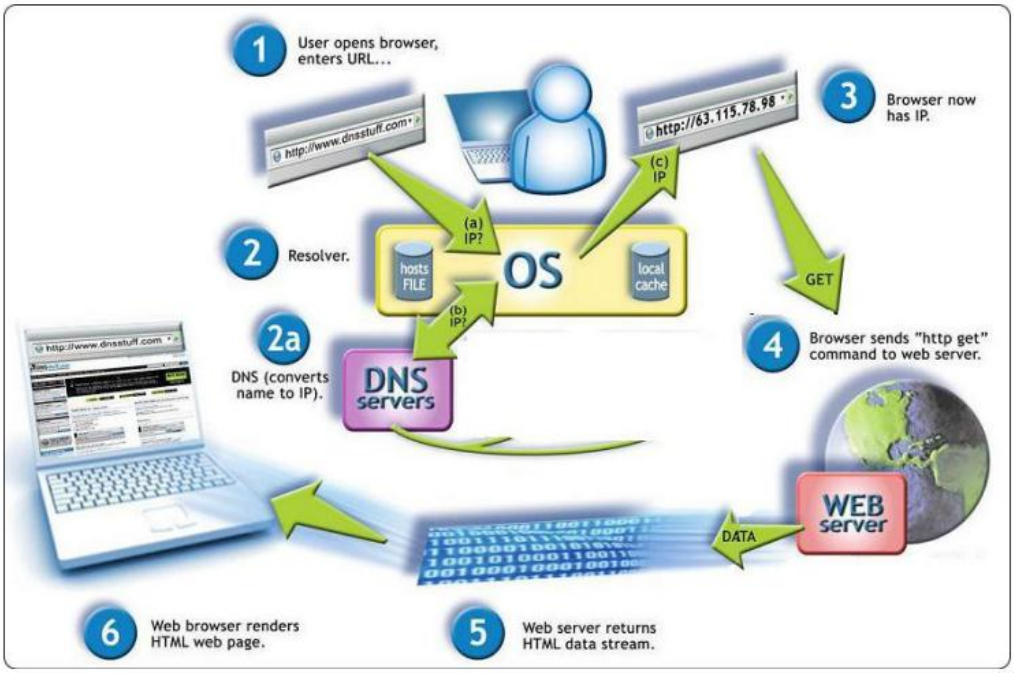
Domain Name Server (DNS):

Domain Name Servers (DNS) are the Internet's equivalent of a phone book. They maintain a directory of domain names and translate them to Internet Protocol (IP) addresses.

1. User types URL of a website in web browser address bar.
2. The web browser sends the request of URL to DNS of internet service provider (ISP).
3. DNS searches the IP address of the URL.
4. URL is translated into machine friendly IP address by DNS.
5. The translated IP address is sent to browser.
6. Browser sends http get command to the server of the IP address where website is hosted.
7. The web server sends HTML data to the client web browser.
8. Web page is displayed on client's browser.



Example Question 3:

(a) (i) Describe what is meant by a client-server model of networked computers.

.....

.....

.....

.....[2]

(ii) Give **two** benefits of using the client-server model.

1 .....

.....

2 .....

.....[2]

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(b) A web page offers a link for users to request another web page. The requested web page contains HTML code.
Put each statement in the correct sequence by writing the numbers 1 to 5 in the right-hand column.

Statement	**Sequence No**
The requested web page is displayed on the client computer	
The user clicks on the hyperlink and the web page is requested from the web server	
The requested web page content is transmitted to the client computer	
The client computer processes the html code using the web browser software	
The web server locates the requested web page	

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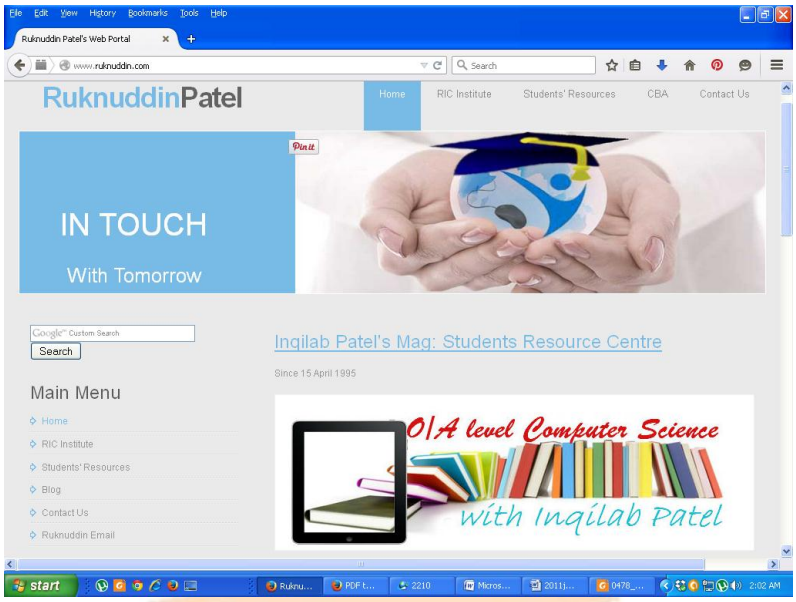
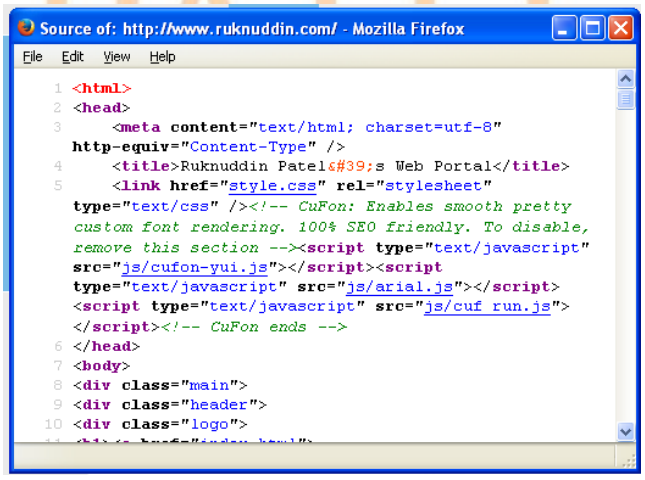
WEB DESIGN



A web page is created by writing code in a language called HTML.
HTML stands for Hyper Text Mark-up Language. It was developed especially to create web pages.
You may be looking at a web page right now and thinking "where is this HTML" - I can't see it.
To see the HTML code of most web pages take these steps:

1. View the page in a web browser.
2. Right click your mouse over the page text and a small menu will appear close to the mouse (right clicking over a picture gives you a different menu) Click on the "View Source" in the menu list.
3. A page full of words and symbols will appear in a separate window

This is the HTML code that makes up the web page you are viewing.



This is what html looks like.

All the coloured text surrounded by **<>** are html 'tags'.

Creating pages using a text editor

HTML is written as text, so you can use any pure text editor such as Notepad to produce the page. The picture below shows one of the most basic web pages you can create.

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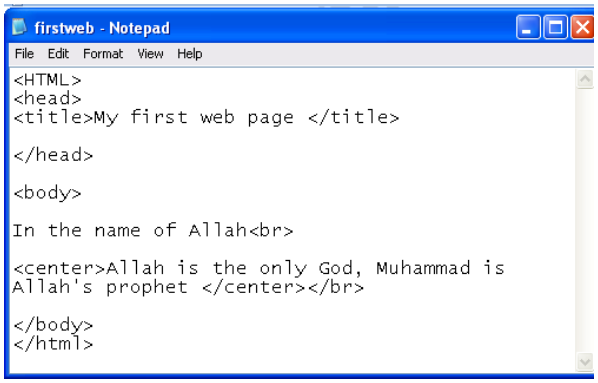

A web page begins with a <HTML> tag and ends with a </HTML> tag. In between, there are two other parts.

1. A head section that begins with <HEAD> and ends with </HEAD>

2. A body section that begins with <BODY> and ends with </BODY>

It is a good idea to use a <TITLE> .....</TITLE> tag that puts a title in the browser window when you view the page.

Text can be formatted using a number of tags <P></P> are the paragraph tags.

Always save the file with an htm or html extension. The one above is called firstweb.HTM

We have actually created this page and can be viewed here. Right click on the new page and select "View Source" to see the HTML code

Advantages	Disadvantages
Very flexible as you have complete control of the HTML code	You have to know a lot about HTML code
Low cost - Notepad is free with Windows. And there are plenty of 'freeware' text editors available on the Internet.	Slow, as all the code has to be written by hand.
	Easy to make a mistake.
	You have to save the file and look at it in a web browser to see what it actually looks like.

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Some Common HTML tags:

Tag	Description
<a>	Defines an anchor
<b>	Defines bold text
<body>	Defines the document's body
 	Defines a single line break
	Defines a section in a document
<form>	Defines an HTML form for user input
<h1> to <h6>	Defines HTML headings
<head>	Defines information about the document
<hr />	Defines a horizontal line
<html>	Defines the root of an HTML document
<img />	Defines an image
<input />	Defines an input control
	Defines a list item
<p>	Defines a paragraph
<script>	Defines a client-side script
<table>	Defines a table
<td>	Defines a cell in a table
<th>	Defines a header cell in a table
<title>	Defines a title for the document
<tr>	Defines a row in a table

HTML Structure

Presentation describes how elements must be rendered on screen.

HTML Presentation:

HTML presentation is format of webpage.
CSS is used to define presentation for web pages, including the design and variations in display for different devices and screen sizes.

When a browser reads a style sheet, it will format the HTML document according to the information in the style sheet.

Three Ways to Insert CSS

There are three ways of inserting a style sheet:

- External style sheet

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- Internal style sheet
- Inline style

External Style Sheet

With an external style sheet, you can change the look of an entire website by changing just one file!

Each page must include a reference to the external style sheet file inside the <link> element. The <link> element goes inside the <head> section:

```
<html>
<head>
<link rel="stylesheet" type="text/css" href="mystyle.css">
</head>
<body>

<h1>In the name of Allah</h1>
<p>The city School, PAF Chapter</p>

</body>
</html>
```

An external style sheet can be written in any text editor. The file should not contain any html tags. The style sheet file must be saved with a .css extension.

Here is how the "myStyle.css" looks:

```
body{
   background-color: #0000ff;
}

h1 {
   color: 000089;
   margin-left: 20px;
}
```

Internal Style Sheet

An internal style sheet may be used if one single page has a unique style.

Internal styles are defined within the <style> element, inside the <head> section of an HTML page:

Example:

```
<html>
<head>
<style>
body {
background-color: #0000ff;
}
```

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```
h1 {
color: #980000;
margin-left: 40px;
}
</style>
</head>
<body>

<h1>In the name of Allah</h1>
<p>The City School, PAF Chapter. </p>

</body>
</html>
```

Inline Styles

An inline style may be used to apply a unique style for a single element.

To use inline styles, add the style attribute to the relevant element. The style attribute can contain any CSS property.

The example below shows how to change the color and the left margin of a <h1> element:

```
<html>
<body>

<h1 style="color: #0000f8; margin-left: 30px ;"> In the name of Allah</h1>
<p>The City School PAF Chapter. </p>

</body>
</html>
```

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Example Question 4:

HTML code for a website is given below:

```
<html>
<head>
<title> O Level Computer Science with Inqilab Patel</title>
<style>
body {
    background-color: #0000ff;
}
h1 {
    color: #980000;
    margin-left: 40px;
}
</style>
</head>
<body>

<h1>In the name of Allah</h1>
<p>The Cambridge O Level Computer Science syllabus enables learners
to develop an interest in computing and gain confidence in computational
thinking and programming. Cambridge O Level Computer Science
is an ideal foundation for further study at Cambridge International
A Level, and the skills learnt can also be
used in other areas of study and in everyday life.</p>

</body>
</html>
```

(a) Which lines in the webpage script are related to presentation (style) code?

…… [1]

(b) By studying the web page script and its use, what is the use in HTML of:

(i) the <h1> tag?

…… [1]

(ii) the <p> tag?

…… [1]

Examination Questions

Q1) Dima has decided to change his dial-up modem for a broadband modem.

(a) Give two advantages of doing this.

1 .....

2 ..... [2]

(b) Dima has agreed to send Michaela a 20 megabyte file. They both have a broadband connection. Dima has to upload his file to a server and then Michaela needs to download it from the same server.

The broadband data transfer rates (speeds) are:

1 megabits per second to upload a file

8 megabits per second to download a file(Note: 8 bits = 1 byte)

(i) How long does it take to upload Dima's file?

.....

..... [2]

(ii) How long does it take to download Dima's file?

.....

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..... [1]

(c) Dima has decided to use wireless LAN (Wi-Fi) connections.
Give one advantage and one disadvantage of doing this.
Advantage .....
.....
Disadvantage .....
..... [2]

Q9) In each case below, state which Internet term is being described.
(a) Malicious software installed on a user's hard drive or a web server; the software re-directs the user to a fake website without their consent or knowledge.
..... [1]
(b) Personal Internet journals where a writer enters text about a certain topic; anyone can comment on the topic.
..... [1]
(c) Websites designed to promote the building of online communities who share the same interests; usually free of charge; users can add friends, post messages to each other and update personal profiles.
..... [1]
(d) Legitimate-looking email sent to a user in the hope of gathering personal information; as soon as the recipient clicks on the link in the email (or email attachment) they are sent to a fake website.
..... [1]
(e) Software that secretly gathers information by monitoring key presses on a user's keyboard; this information is relayed back to the person who sent the software originally.
..... [1]

Q10) A rock band uses an internet website to advertise its music.

a) The website uses HTML.

i. Describe HTML
.....
.....
..... [2]

ii. Explain the importance of HTML in the creation of web pages
.....
.....
..... [2]

b) A list of file extension for common file standards used on the internet is shown below:
JPG PDF MP3 MPEG ZIP
The rock band allows some files to be downloaded by fans.
Complete the table below to show which file format **from the list given above** may be used for each of the following files:

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File	File Format
A high resolution image of the band to use as a desktop background.	
Sheet music of their songs ready to be printed in the correct format for guitar players.	
A short video extracted from their latest tour.	
A compressed collection of 200 plain text files containing lyrics of all their songs.	
An audio recording of a song from their album.	

Q11) Ahmed uses the Internet for some time and is puzzled by the terminology.
(a) Draw a line to match each description to the appropriate technical term. [5]

authoring language used to create documents to be viewed on the World Wide Web	Browser
computer that responds to requests to provide information and services over the Internet	HTML
defines how messages are transmitted and formatted over the Internet	MAC address
numerical ID for each device on the Internet	Internet Server
software that enables users to access/view documents and other resources on the Internet	IP address
unique ID for a network interface card	http

(b) Ahmed sees the message "Set your browser to accept cookies".
Explain why some websites make this request.
.....
..... [2]

Q12) Summer 2011
A company has decided to introduce an intranet and remove Internet access for its staff.
(a) Describe TWO reasons why the company will not allow its staff Internet access.

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1 .....

2 ..... [2]

(b) Apart from removing Internet access, give TWO advantages to the company of using an intranet.

1 .....

2 ..... [2]

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Marking Scheme

Example Questions:

Q2)
(i) http – enables browser to know what protocol is being used to access information in the domain
cie.org.uk – cie.org.uk is the domain name
computerscience.html – actual web page / file being viewed [3]
(ii) %20 – because <space> not allowed in a URL, %20 is the coding for a space (32 in denary)
? – separates the URL from all parameters or variables [2]

Q3)(a) (i) – at least one computer used to "serve" …
– … other computers are referred to as "clients"
– server provides services / applications etc. …
– … which may be requested by clients [2]
(ii) any two from:
– files and resources are centralised
– creation of security / manage security
– user needs user name and password to access network
– centralised back-up
– intranet capability
– Internet monitoring
– clients can be less powerful machines, therefore less expensive to buy
– saving resources on server reduces the burden on the client [2]

Examination Questions:

Q6) 1 mark for each benefit and 1 mark for each drawback (maximum of 2 marks for each communication method).

mobile phones
benefit:
– wireless system (so can be used anywhere)
– small, portable device/always with you
– instantaneous (e.g. take photo and immediately transfer file)
– can leave messages if recipient not available
drawback:
– contracts tend to be expensive
– phone calls overseas are very expensive
– out of signal
– battery life poor
– data transfer rate can be slow
– not very large memories
– small screens/keyboards make it more difficult to type/navigate

video conferencing
benefit:
– many people can take part in conference across the world
– can see all delegates on screen (and also talk in synchronised way)
– relatively inexpensive since uses Internet for communications
– can hold meeting of several people at short notice
– no need to pay for travelling/hotels/meeting rooms
– less time wasted travelling to meetings overseas/staff not out of office
– safer – recent increased risk of terrorist attacks
drawback:
– equipment is expensive to buy initially
– quality of sound/picture can be poor (poor reception)
– problems with time zones
– fast internet connection required

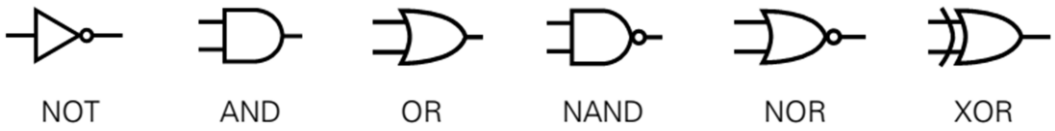
emails:
benefit:
– can send at any time/recipient can open any time
– inexpensive (same cost worldwide)
– can send large multimedia files
– no need for expensive equipment
– can send to multiple recipients
– can use attachment facility
drawback:
– if recipient doesn't have correct software, can't open attachments
– possibility of virus infections/phishing from attachments
– need Internet connection/ISP
– may not get immediate response (ONLY IF REVERSE NOT GIVEN UNDER BENEFIT) [6]

1.3 Hardware and software

1.3.1 Logic Gates

Many electronic circuits have to make decisions. They look at two or more inputs and use these to determine the outputs from the circuit. The process of doing this uses electronic logic, which is based on digital switches called **Logical Gates.**

Candidates should be able to:

- Use logic gates to create electronic circuits
- Understand and define the functions of NOT, AND, OR, NAND, NOR and XOR (exclusive or) gates, including the binary output produced from all the possible binary inputs (all gates, except the NOT gate, will have 2 inputs only)
- Draw truth tables and recognise a logic gate from its truth table
- Recognise and use the following standard symbols used to represent logic gates:
- 

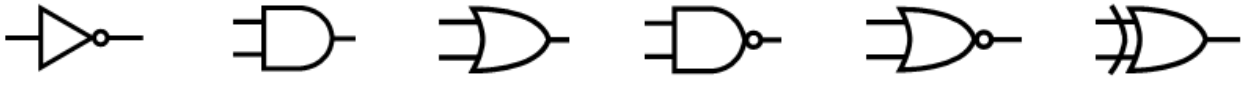
- Produce truth tables for given logic circuits, for example:

a	b	c	output
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

- Produce a logic circuit to solve a given problem or to implement a given written logic statement, such as IF (switch A is NOT on) OR (switch B is on

Logic gates are devices that can combine multiple inputs at independent logic levels and come up with an output accordingly. They are used by implementing Boolean algebra. Logic gates have two or more input and one output except NOT Gate which has one input and one output.

The most common Logical Gates are given below:



For example, The most obvious use is for simple control. Imagine designing a washing machine so that the water only turns on when the washing is loaded (logic-1), the door is closed (logic-1) but the clothes are not yet wet (logic-0). This can be done by ANDing the first two conditions, and inverting the third. Now, AND these together, and you get a high

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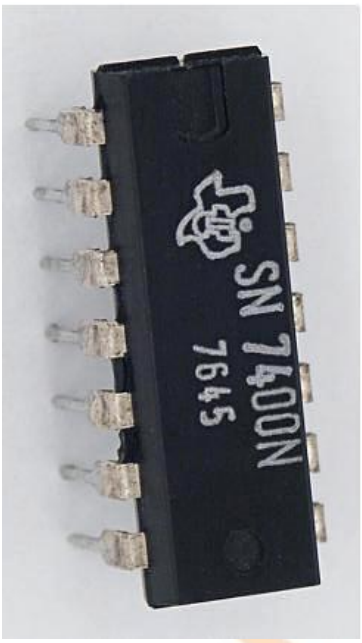
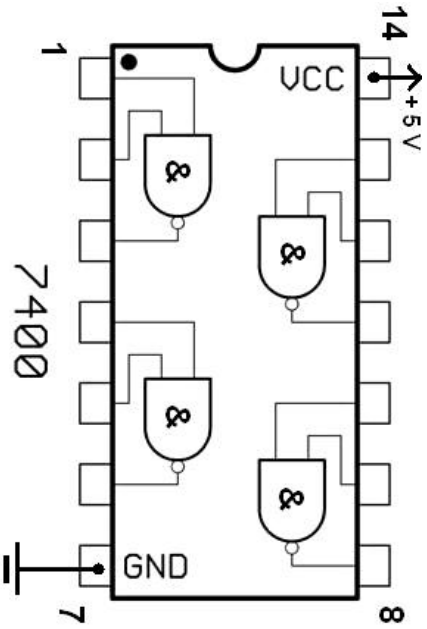
only when all three conditions are satisfied.
Two or more logic gates can be connected to produce a logic circuit with one or more outputs from two or more inputs.





Truth Tables:

"A truth table is used to show the output of a logic gate or circuit for all possible combinations of input values."
Usually the binary values are used, 1 and 0, as shorthand for True and False.
The truth table for a two-input gate needs four rows (2^2=4) while for 3-input gate needs eight rows (2^3=16).

1) NOT Gate (Inverter):

A **NOT gate** or an **inverter** is the simplest kind of logic gate. Its function is to give the opposite output to its input - if it gets a high (1), it gives a low (0), and vice versa. This is equivalent to saying that the output is *not* the input.

NOT Gate	
Input A	Output X
0	1
1	0

The output X) =1 if
INPUT A is **NOT 1**(i.e. **0** or **OFF**).

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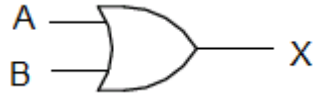
2) AND Gate

An **AND gate** gives an output 1 only when both inputs are 1.
If one or more inputs are 0, then the output is also 0.

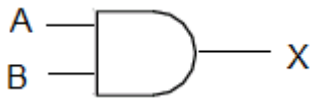


Input A	Input B	Output x
0	0	0
0	1	0
1	0	0
1	1	1

The output (called X) is **true** (i.e. **1** or **ON**) only if the (**INPUT A AND INPUT B**) are both **true** (i.e. **1** or **ON**).
The x=1 if
INPUT A is 1 AND INPUT B is 1

3) OR Gate

An **OR gate** gives a high (1) output if any input is high (1). If all inputs are low (0), then the output is low (0).

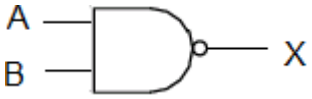


Input A	Input B	Output x
0	0	0
0	1	1
1	0	1
1	1	1

The output (called X) is **true** (i.e. **1** or **ON**) if the (**INPUT A OR INPUT B**) are **true** (i.e. **1** or **ON**).
The OUTPUT X=1 IF
Either INPUT A is 1
OR INPUT B is 1

4) NAND Gate

This NOT AND combination is shortened to just NAND. A **NAND gate** gives a 0 output only when both inputs are 1. If one or more inputs are 0, then the output is 1.



Input A	Input B	A AND B	OUTPUT X
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

The output (called X) is **true** (i.e. **1** or **ON**) if (**INPUT A AND INPUT B**) are **NOT** both **true** (i.e. **1** or **ON**). Is 1

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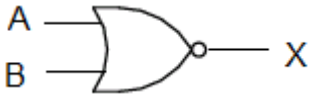
5) NOR Gate

This NOT OR combination is shortened to just NOR. A **NOR gate** gives a 1 output only if no inputs are 1. If an input is 0, then the output is 0.



Input A	Input B	A OR B	OUTPUT X
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

The OUTPUT x=0 IF
Either INPUT A is 1 OR INPUT B is 1

6) XOR Gate

The '**Exclusive-OR**' gate is a circuit which will give a 1 output if **either, but not both**, of its two inputs are 1. If both inputs are same then output will be 0 else output will be 1

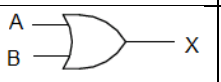
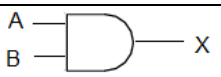
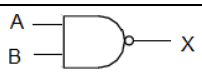
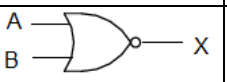
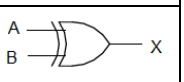
Input A	Input B	Output x
0	0	0
0	1	1
1	0	1
1	1	0

The OUTPUT X=1 IF
Either A is 1 AND B is NOT 1
Or A is NOT 1 AND B is 1

Truth tables

A truth table is used to show the output of a logic gate or circuit for all possible combinations of input values; we usually use the binary values, 1 and 0, as shorthand for True and False.

The truth table for a two-input gate needs four rows.

INPUT		OR	AND	NAND	NOR	XOR
A	B					
0	0	0	0	1	1	0
0	1	1	0	1	0	1
1	0	1	0	1	0	1
1	1	1	1	0	0	0

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Combinational logic circuits with two inputs

Two or more logic gates can be connected to produce a logic circuit with one or more outputs from two or more inputs. A logic circuit can process logical expressions and binary numbers.

When producing a truth table for a logic circuit:

• it is helpful to add a column for each intermediate output as well as for the final output

• as for a single logic gate with two inputs, a logic circuit with two inputs needs four rows.

Combinational logic circuits with three inputs

We only need to be able to produce a truth table for a logic circuit with a maximum of three inputs and six gates.

The truth table for a three-input logic circuit needs eight rows.

Designing simple logic circuits

Sometimes, it is cheaper to design and hard-wire a logic circuit for a simple automated system that only requires a fixed pattern of output depending on the current values of the inputs, than to program a microcontroller or computer.

We can use the words AND, OR, NOT, NAND and NAND as operators in a logical equation, such as L = (A AND B) OR NOT B. We use brackets to indicate that the logical operation within the brackets takes priority.

We can design a logic circuit to solve a written statement of a logical problem. First, we rewrite the statement using brackets to clarify the binary value of each variable and the priority of the logical operations. Then we can write the logical equation. From the logical equation, if not an earlier stage in the rewriting process, it should be possible to draw the required logic circuit and a truth table to confirm that it has the required behaviour.

Testing logic circuits

We have seen how to use a truth table to check whether a logic circuit has solved a given problem, rather as we use a trace table for dry running a flowchart or pseudocode algorithm. We can also check that a logic circuit solves the problem by building the circuit using logic simulation software or electronic circuitry, with appropriate attention to safety.

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Examination Questions

Q1) Identify each of the following gates from truth table:

INPUT 1	INPUT 2	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	1

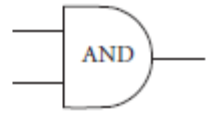
INPUT 1	INPUT 2	OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

INPUT 1	INPUT 2	OUTPUT
0	0	1
0	1	0
1	0	0
1	1	0

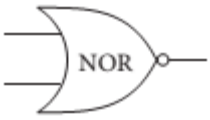
INPUT 1	INPUT 2	OUTPUT
0	0	1
0	1	1
1	0	1
1	1	0

INPUT	OUTPUT
0	1
1	0

Q2) Complete the following truth table



INPUT 1	INPUT 2	OUTPUT
0	0	
0	1	
1	0	
1	1	



INPUT 1	INPUT 2	OUTPUT
0	0	
0	1	
1	0	
1	1	

Q3) Draw the logic circuit required to fulfil the following statements:
a Output C = (NOT(A AND B)) AND (A OR B)

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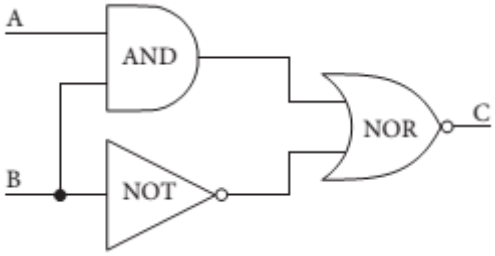
b Light (L) is **on** if Switch A is **on** OR (Switch B is **on** AND Input C is **off**.

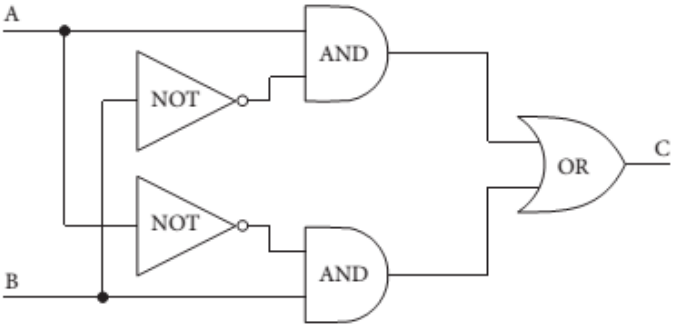
Q4) Copy and complete the truth tables for the following logic circuits:

a



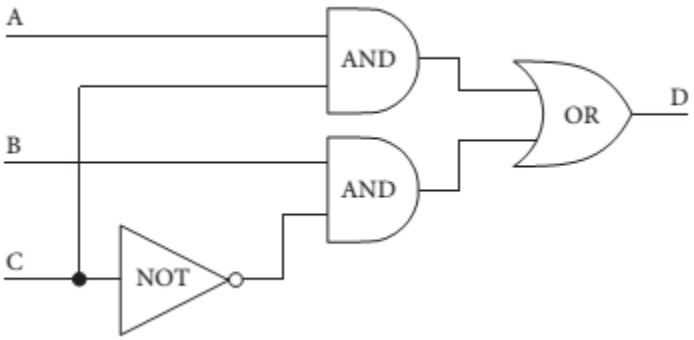
INPUT 1	INPUT 2	OUTPUT
0	0	
0	1	
1	0	
1	1	

b



INPUT 1	INPUT 2		OUTPUT
0	0		
0	1		
1	0		
1	1		

c



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INPUT 1	INPUT 2		OUTPUT
0	0		
0	1		
1	0		
1	1		

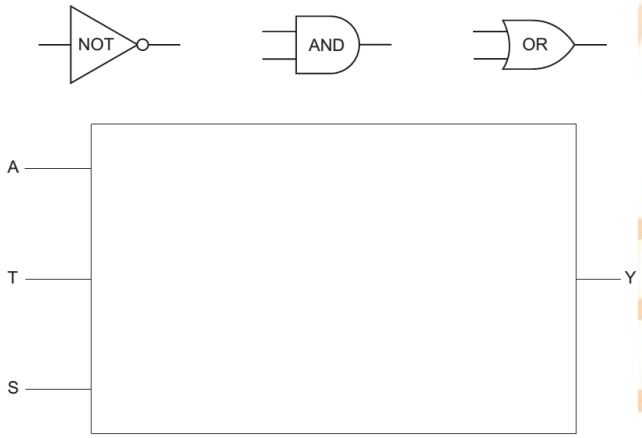
Q5) Specimen 2015 P1 (Q3)

An alarm, Y, sends a signal (Y = 1) when certain fault conditions in a chemical process are detected. The inputs are:

Input	Binary value	Condition
A	1	acidity > 5
	0	acidity <= 5
T	1	temperature >= 120UC
	0	temperature < 120UC
S	1	stirrer bar ON
	0	stirrer bar OFF

The alarm, Y, returns a value of 1 if:
either temperature >= 120°C AND stirrer bar is OFF
or acidity > 5 AND temperature < 120°C

(a) Draw the logic circuit for the above system using these logic gates. [5]



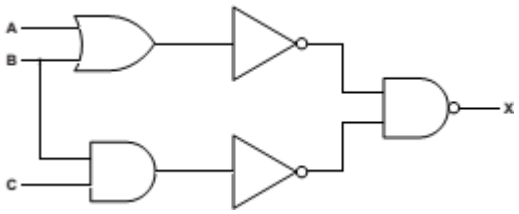
A	T	S		Y
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

(b) Complete the truth table for this alarm system. [4]

Q6) Winter 2014 P12-13

(a) Complete the truth table for the following logic circuit:

A	B	C	Working	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		



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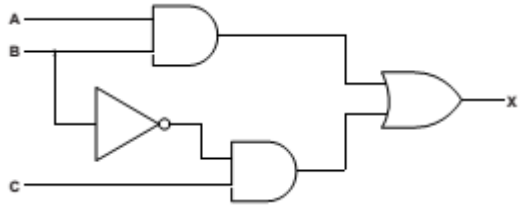
(b) Re-draw the logic circuit shown opposite, using NAND and NOR gates only

(c) Write a logic statement that describes the following logic circuit:

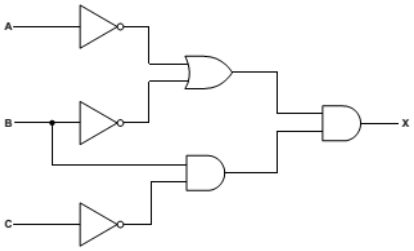


.....

.....

.....[3]

(c) Write a logic statement that describes the following logic circuit:



A	B	C	Working	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

.....

..... [3]

Q7) Summer 2014 P11 (Q7)

(a) Draw the logic circuit for the logic statement:

X = 1 if (L is NOT 1 AND F = 1) OR (F is NOT 1 AND A is 1) [5]

(b) Complete the truth table for the above system [4]

L	F	A	Working	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

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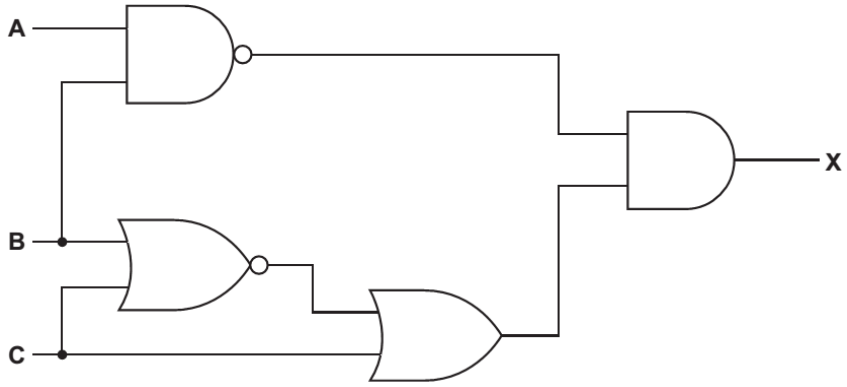
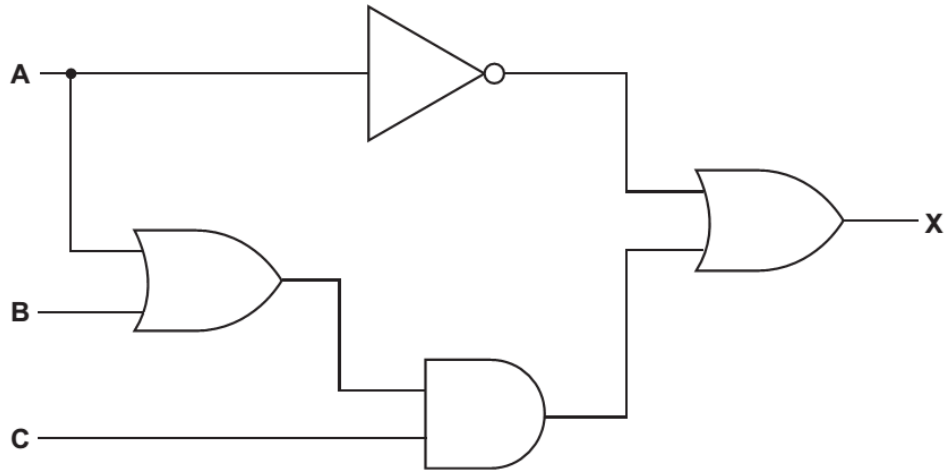
Q8) Summer 2014 P12 (Q17)

(a) Complete the truth table for the following logic circuit: [4]



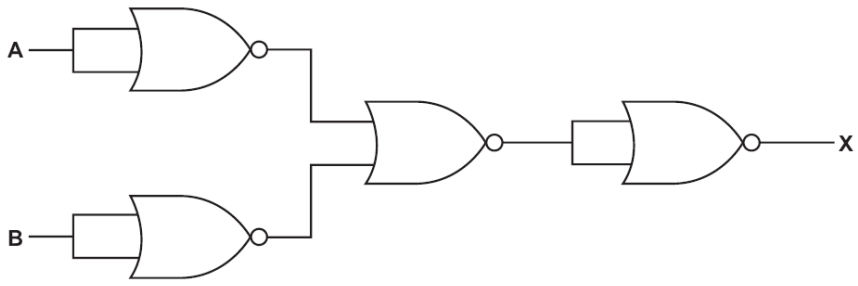
A	B	C	Working	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

(b) Write the logic statement to describe the following logic circuit: [3]



Q9) Winter 2013 P12 (Q10)

(a) (i) Complete the truth table for the following logic circuit which is made up of NOR gates only.



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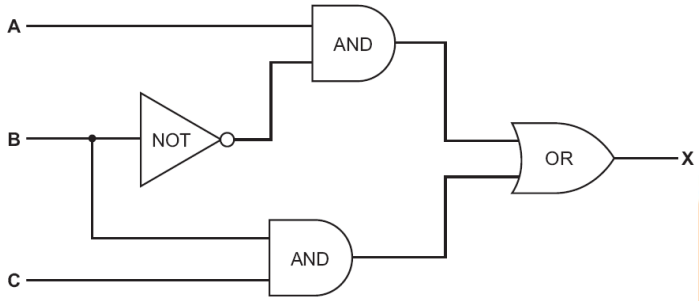
A	B	Working	X
0	0		
0	1		
1	0		
1	1		

(ii) What single logic gate has the same function as the above circuit? [1]

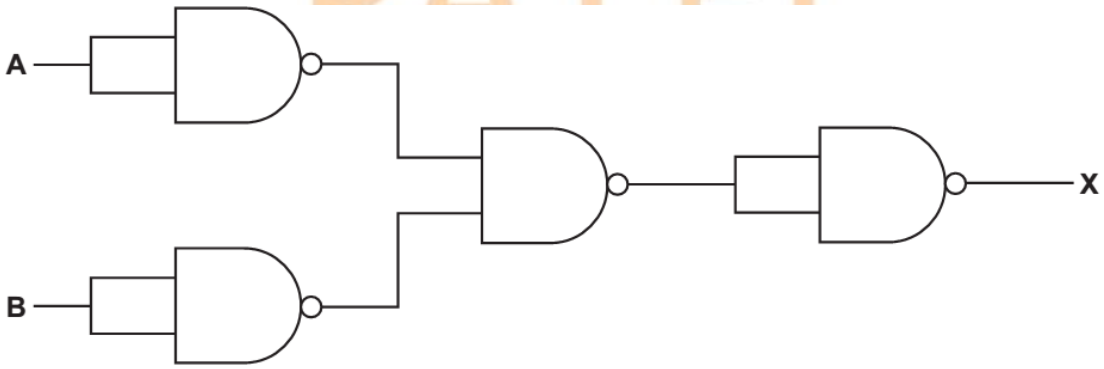
(b) Complete the truth table for the following logic circuit.



A	B	C	Working	X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

Q10) Summer 2013 P11 (Q10)

(a) (i) Complete the truth table for the logic circuit which is made up of NAND gates only.



A	B	Working	X
1	1		
1	0		
0	1		
0	0		

(ii) What single logic gate has the same function as the above logic circuit? [1]

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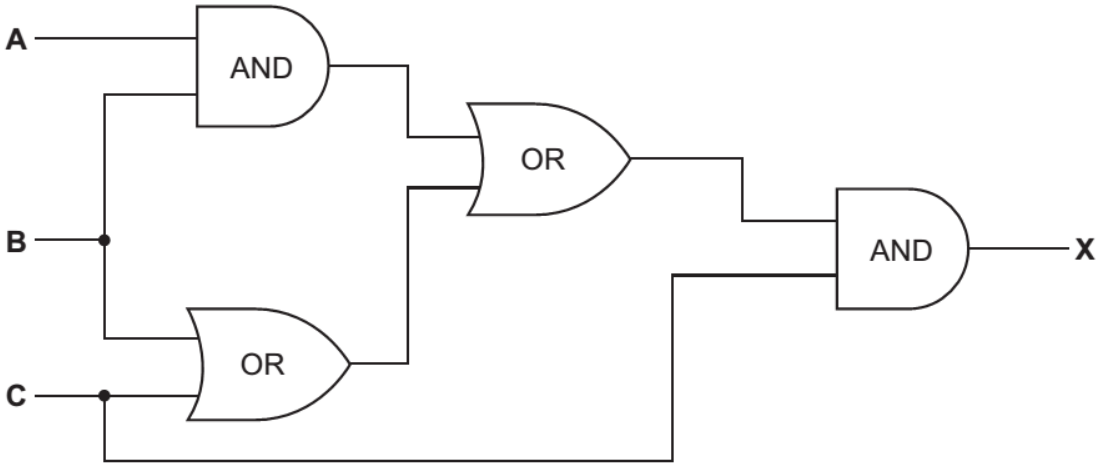
(b) (i) Complete the truth table for the logic circuit.



A	B	C	Working	X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

(ii) What could replace the whole logic circuit?

.....

..... [1]

Q11) Summer 2013 P12 (Q15)

(a) Draw the logic circuit represented by the logic statement:

X = 1 if (B is NOT 1 AND S is NOT 1) OR (P is NOT 1 AND S is 1) [6]

b) Complete the truth table for the above logic statement. [4]

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B	S	P	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Q12) Winter 2012 P12 (Q11)

An alarm sounds when certain conditions occur in a nuclear reactor.

The output, X, of a logic circuit that drives the alarm must have a value of 1 if:

either carbon dioxide pressure too low and temperature < = 300°C

or water pressure > 10 bar and temperature > 300°C

The inputs to the system are:

Input	Binary	Condition
P	0	carbon dioxide pressure too low
	1	carbon dioxide pressure acceptable
T	0	temperature > 300°C
	1	temperature < = 300°C
W	0	water pressure > 10 bar
	1	water pressure < = 10 bar

(a) Draw the required logic circuit using AND, OR and NOT gates only.

[5]

(b) Complete the truth table for the above system. [4]

P	T	W		X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

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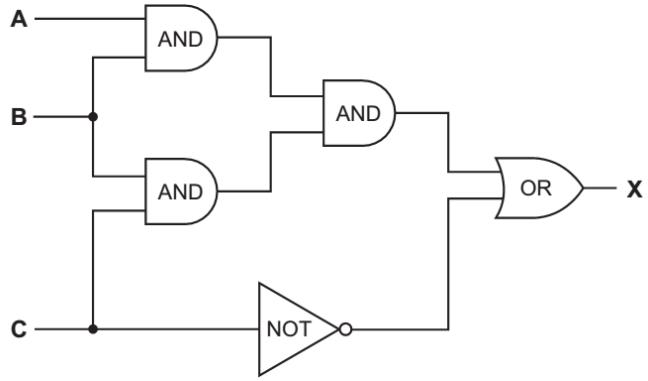
Q13) Winter 2012 P13

(a) Complete the truth table for the following logic circuit: [4]



A	B	C		X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

(b) The above logic circuit uses AND, OR and NOT gates.

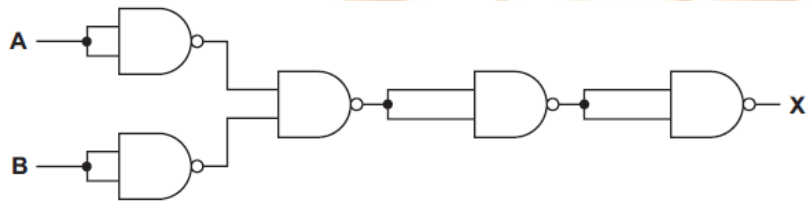
Name another logic gate and complete its truth table. [3]

Name : _____

A	B	X
0	0	
0	1	
1	0	
1	1	

Q14) Summer 2012 P11

(a) (i) Complete the truth table for the following logic circuit, which is made up of NAND gates:

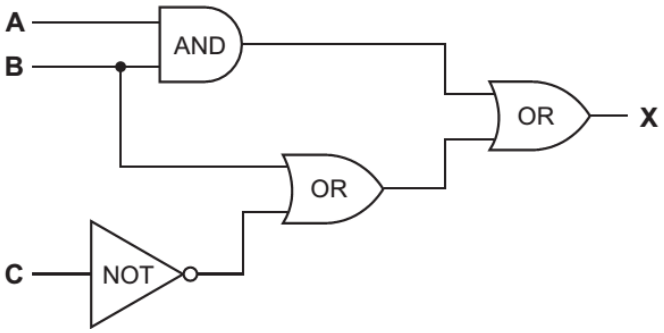


A	B	X
0	0	
0	1	
1	0	
1	1	

(ii) What single logic gate has the same function as the above logic circuit?

..... [1]

b) Complete the truth table for the following logic circuit:



A	B	C		X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

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Q16) Specimen 2011 P1

Draw a logic network and truth table for the following logic problem:

"A sprinkler(S) is On if

Either temperature alarm (T) is ON and cooler alarm (C) is ON

Or vent alarm (V) is OFF and cooler alarm (C) is ON" [9]

Working:

_____

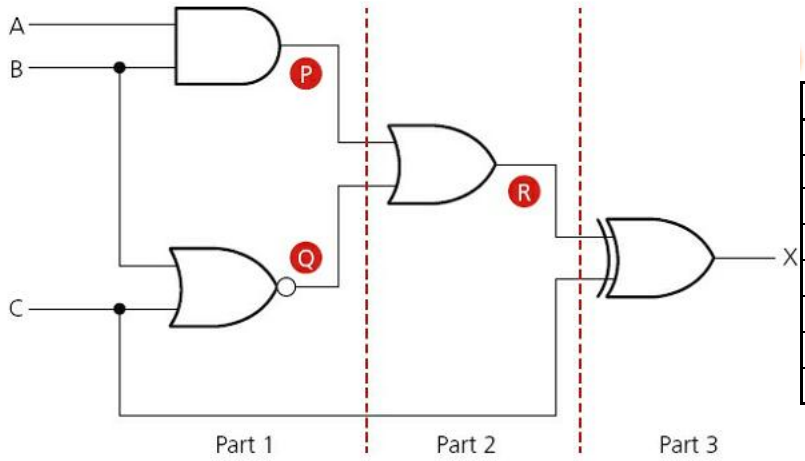
_____ [2]

Logic Network:

Truth Table:

T	C	V		S
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

Q 17) Complete the truth table for the following logic circuit:



A	B	C		X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

Q18)Complete the truth table for the following logic circuit:

A	B	C		X

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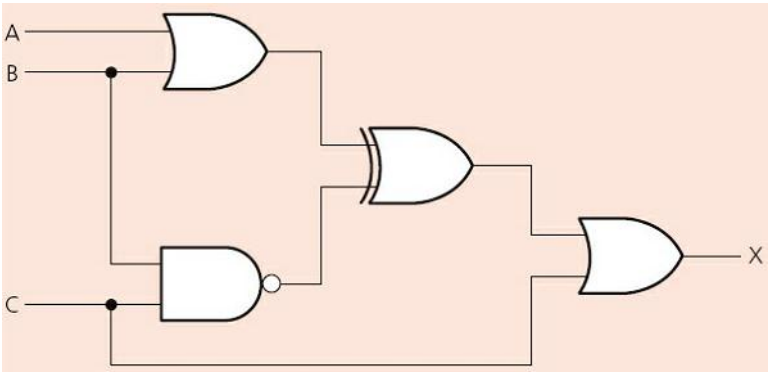
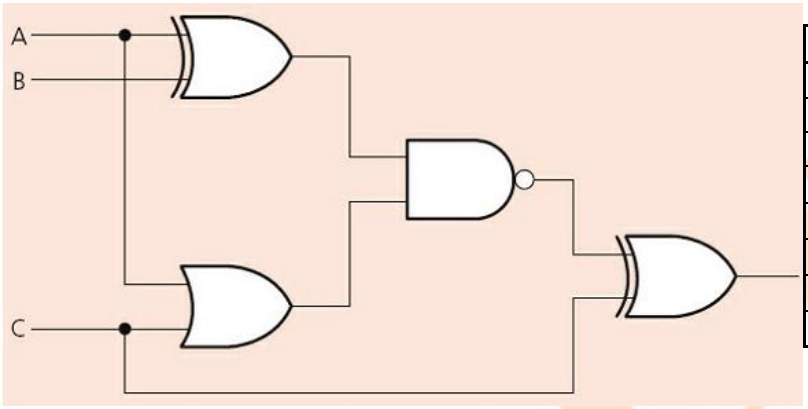
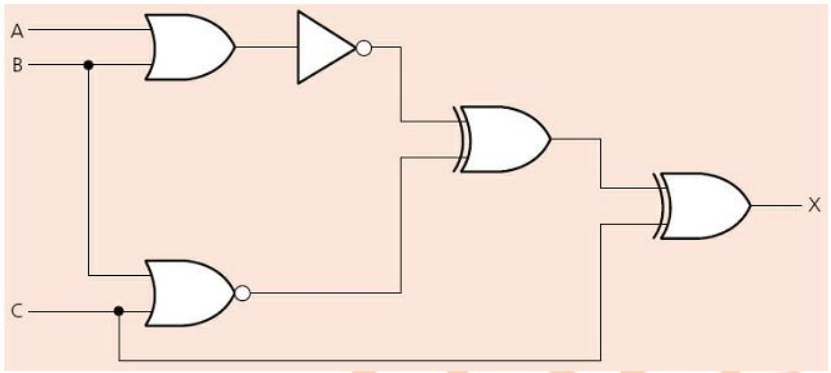


1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

Q19) Complete the truth table for the following logic circuit:



A	B	C		X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		



Simplification Logic Circuit:

Simplification means reducing the number of components in a logic circuit. As a result of simplification the cost of production can be less. This can also improve reliability and make it easier to trace faults if they occur.

Q20) Show by drawing a truth table which single logic gate or what else has the same function as the logic circuit drawn in

a)

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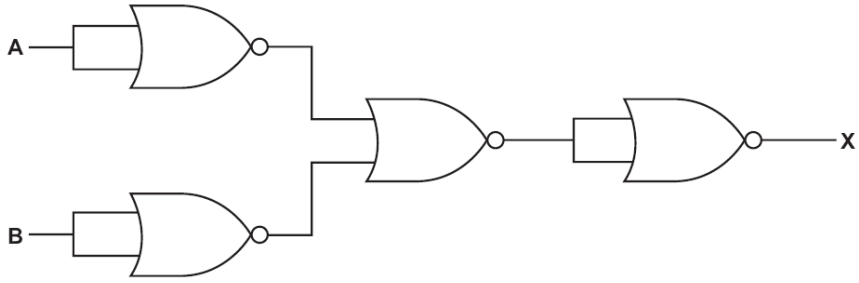
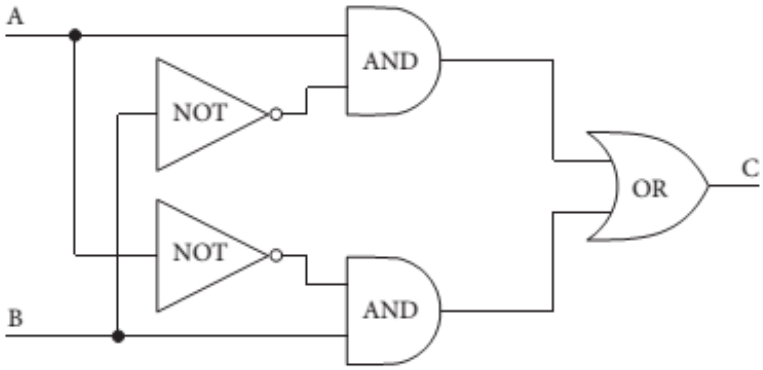
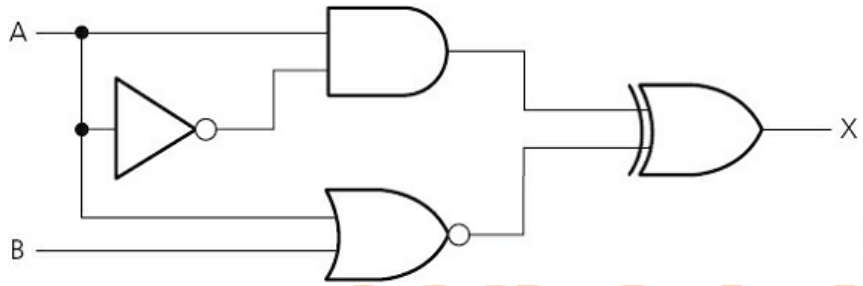


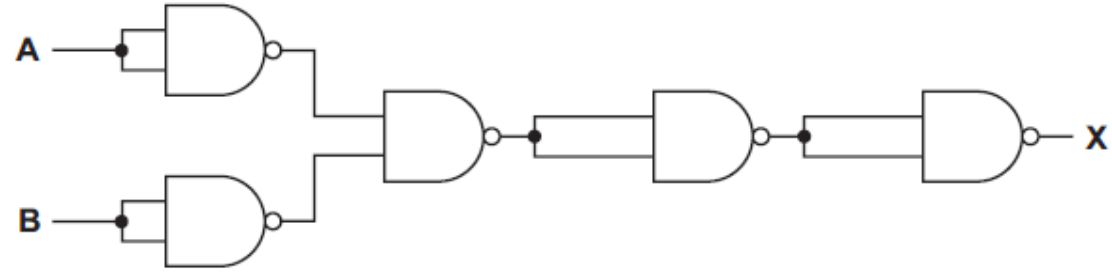
b)



c)



d)



What could replace the whole logic circuit?

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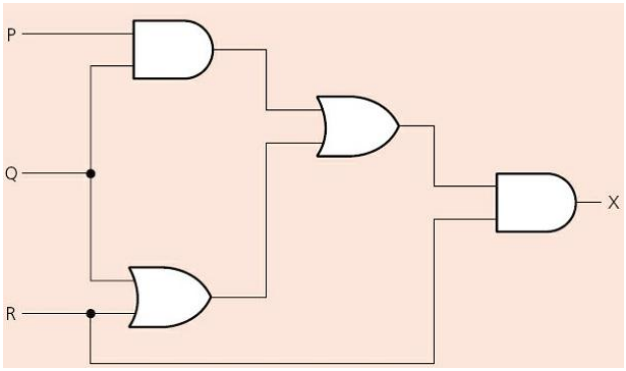
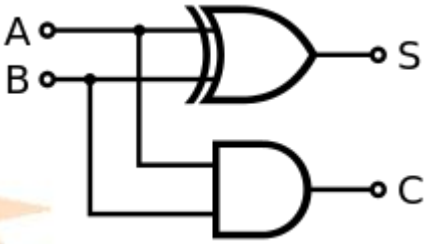


Half Adder”

The **half adder** adds two single binary digits *A* and *B*. It has two outputs, sum (*S*) and carry (*C*). The carry signal represents an overflow into the next digit of a multi-digit addition.

The simplest half-adder design, pictured on the right, incorporates an XOR gate for *S* and an AND gate for *C*. With the addition of an OR gate to combine their carry outputs, two half adders can be combined to make a full adder



Inputs		Outputs	
A	***B***	***C***	***S***
0	0	0	0
1	0	0	1
0	1	0	1
1	1	1	0

PATEL

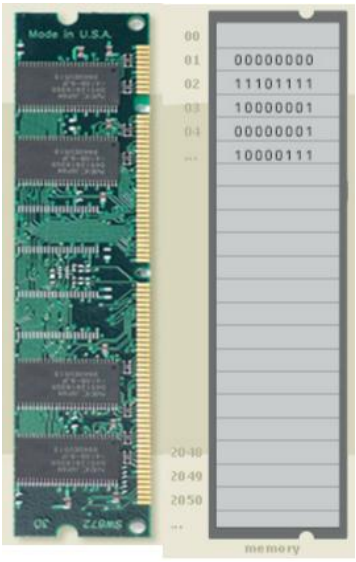
1.3.2 Computer architecture and the fetch-execute cycle

1.3.2 Computer architecture and the fetch-execute cycle • show understanding of the basic Von Neumann model for a computer system and the stored program concept (program instructions and data are stored in main memory and instructions are fetched and executed one after another) • describe the stages of the fetch-execute cycle

Courtesy to http://web.eecs.utk.edu/research/cs100modules/module1/index.html

Von Neumann Architecture

The idea about how computers should be built was proposed by John von Neumann in 1945. This idea is called the **von Neumann Architecture** or **Model**. This is still the basis for computers today. Using these four components, a von Neumann computer will execute a series of instructions, called a program, which are stored in the computer's memory. This is called the "**stored program concept**".



The components of von Neumann Architecture is:

1. Input/output (I/O)
2. Memory
3. A Control Unit
4. An Arithmetic Logic Unit (ALU)

Input/output (I/O) Devices

The Input/output (I/O) components of a computer are hardware devices that are responsible for getting data from the computer to the user or from the user to the computer.

Data going from the user to the computer is called "input." The two main input devices are the mouse and the keyboard.

Output devices are used to transmit data from the computer's memory to the user. The two output devices almost every computer system has are the monitor and the printer.

Memory Unit

Computer has several types of memory. Memory unit in the Von Neumann model is the main memory, also called RAM or Random Access Memory.

Main memory is used by the computer for storing a program and its data while the program is running. What distinguishes a computer from a calculator is the ability to run a stored program; main memory allows the computer to do that.

RAM can be thought of as a sequence of boxes, called cells, each of which can hold a certain amount of data.

The remaining three components of the von Neumann model of a computer are found inside the Processor.

Control Unit

The control unit controls the sequencing and timing of all operations. It contains a "clock," that is actually a quartz crystal that vibrates million times per second. The clock emits an electronic signal for each vibration. Each separate operation is synchronized to the clock signal. For example 1st pc operates at 4.7 MHz means 4.7 million instructions per second.

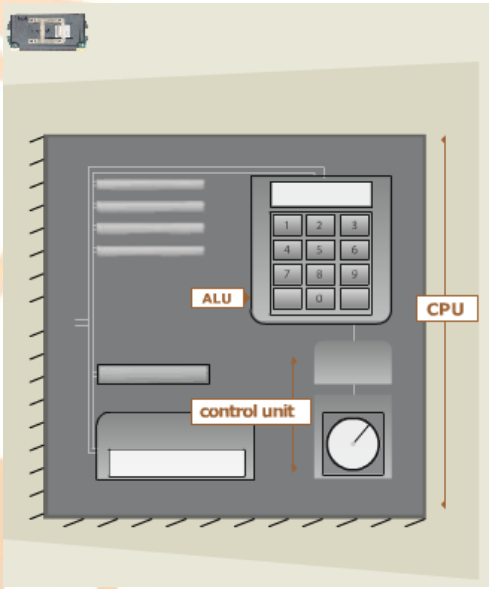
The functions of CU are given below:

- Interprets and carries out instruction of program.
- Selects program statements from memory.
- Moves these instructions to instruction registers
- Carries out instructions
- Directs flow of data between components of CPU and to and from other devices.

Arithmetic & Logic Unit (ALU)

Arithmetic unit perform arithmetical operations like +, -, *, and / while logical unit are to compare two quantities. Logical operations are important in computer programming.

ALU can be thought of as being similar to a calculator, except that, in addition to normal math, it can also do logical (true/false) operations.



The functions of ALU are given below:

- The arithmetic unit carries out arithmetic like addition, division.
- The logic unit enables the processor to make comparison like =, <, > and logical decisions like AND, OR, NOT.
- The arithmetic logic unit carries out communication with peripheral devices.
- It also carries out bit shifting operation.

Register:

Registers are Immediate Access Store (IAS) located on the CPU, and used temporarily for storing data. Because the registers are close to the ALU, they are made out of fast memory, efficiently speeding up calculations.

There are 14 registers. Some examples are

a) **Program Counter (PC)** - an incrementing counter that keeps track of the **next memory address** of the instruction that is to be executed once the execution of the current instruction is completed.
b) **Memory Address Register (MAR)** - the address in main memory that is currently being read or written

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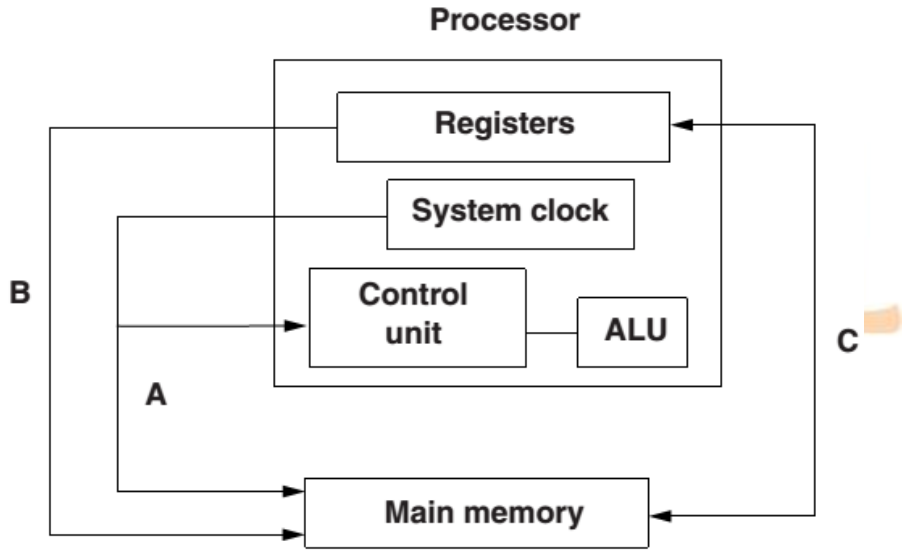
c) **Memory Buffer/Data Register (MBR/MBR)** - a two-way register that holds data fetched from memory (and ready for the CPU to process) or data waiting to be stored in memory
d) **Current Instruction register (CIR)** - a temporary holding ground for the instruction that has just been fetched from memory
e) **Accumulator Register (ACC)**is used for storing data for ALU to process and the results those are produced by the ALU.

Buses: "The set of wires used to travel signals to and from CPU and different components of computer is called Bus."

Bus is a group of parallel wires that is used as a communication path. As a wire transmits a single bit so 8-bits bus can transfer 8 bits (1 byte) at a time and 16-bits bus can transfer 16 bits (2 bytes) and so on. There are three types of buses according to three types of signals, these are:

a) **Data Bus:** "The buses which are used to transmit data between CPU, memory and peripherals are called Data Bus."
b) **Address Bus:** "The buses which are connecting the CPU with main memory and used to identify particular locations (address) in main memory where data is stored are called Address Buses."
c) **Control Bus:** The wires which are used to transmit the control signals (instructions) generated by Control Unit to the relevant component of the computer.

Example Question



The diagram above shows a simplified form of processor architecture.
Name the three buses labelled A, B and C.

A .....
B .....
C ..... [3]

A = control bus *B = address bus* *C = data bus*

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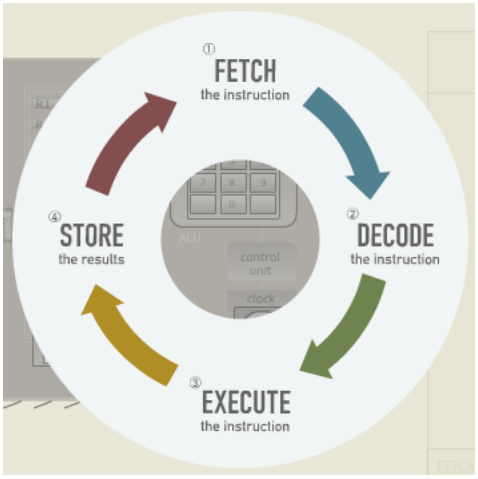
Fetch-Execute Cycle:

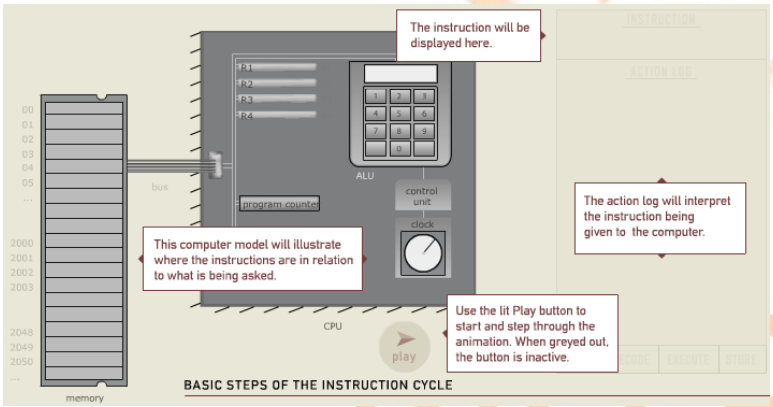
At its core, all the computer ever does is, execute one instruction in memory after another, over and over. Although there are many different possible (assembly language) instructions that the computer can execute, the basic steps involved in executing an instruction are always the same, and they are called the instruction cycle.



1. **Fetch** the instruction (transfer the instruction from main memory to the decoder)
2. **Decode** the instruction (from machine language)
3. **Execute** the instruction (e.g., add, divide, load, store...)
4. **Store** the result (for instructions like ADD, place the 'answer' in the specified register.)

The control unit guides the computer's components through this cycle to execute one instruction.

When that instruction is done, the cycle starts all over again with the next instruction.



Registers/circuits involved

The circuits used in the CPU during the cycle are:

- **Program Counter (PC)** - an incrementing counter that keeps track of the **next memory address** of the instruction that is to be executed once the execution of the current instruction is completed.
- **Memory Address Register (MAR)** - the address in main memory that is currently being read or written
- **Memory Buffer Register (MBR)** - a two-way register that holds data fetched from memory (and ready for the CPU to process) or data waiting to be stored in memory
- **Current Instruction register (CIR)** - a temporary holding ground for the instruction that has just been fetched from memory

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- **Accumulator Register (ACC)**is used for storing data for ALU to process and the results those are produced by the ALU.
- **Control Unit (CU)** - decodes the program instruction in the CIR, selecting machine resources such as a data source register and a particular arithmetic operation, and coordinates activation of those resources
- **Arithmetic logic unit (ALU)** - performs mathematical and logical operations

The table shows six stages in the von Neumann fetch-execute cycle.
Put the stages into the correct sequence by writing the numbers 1 to 6 in the right hand column. [6]

Description of stage	Sequence number
the instruction is copied from the Memory Data Register (MDR) and placed in the Current Instruction Register (CIR)	**3**
the instruction is executed	**6**
the instruction is decoded	**5**
the address contained in the Program Counter (PC) is copied to the Memory Address Register (MAR)	**1**
the value in the Program Counter (PC) is incremented so that it points to the next instruction to be fetched	**4**
the instruction is copied from the memory location contained in the Memory Address Register (MAR) and is placed in the Memory Data Register (MDR)	**2**

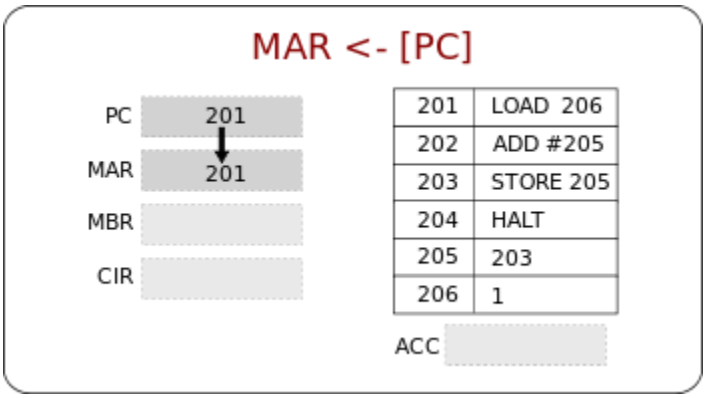
Register notation

To describe the cycle we can use register notation. This is a very simple way of noting all the steps involved. In all cases brackets e.g. [PC], means that the contents of the thing inside the brackets are loaded. In the case of the first line, the contents of the program counter are loaded into the Memory Address Register.

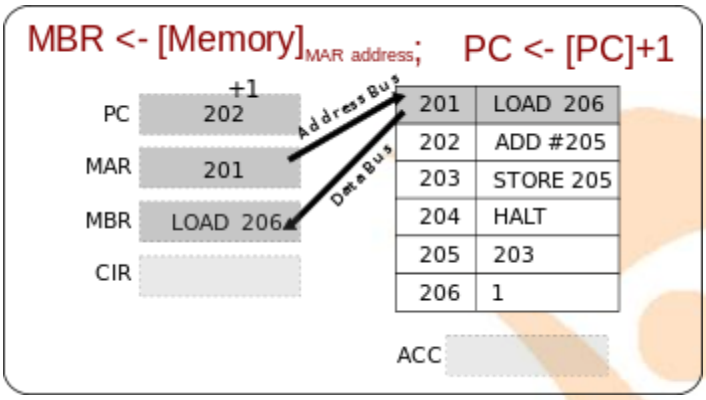
MAR ← [PC]
MBR ← [Memory] ; PC← [PC] +1 (Increment the PC for next cycle at the same time)
CIR ← [MBR]
CIR sends instruction to Decoder of control unit
Decoder decodes
Or ACC← [MBR]
ACC sends data to ALU
ACC executes

Detailed description of Fetch-Decode-Execute Cycle

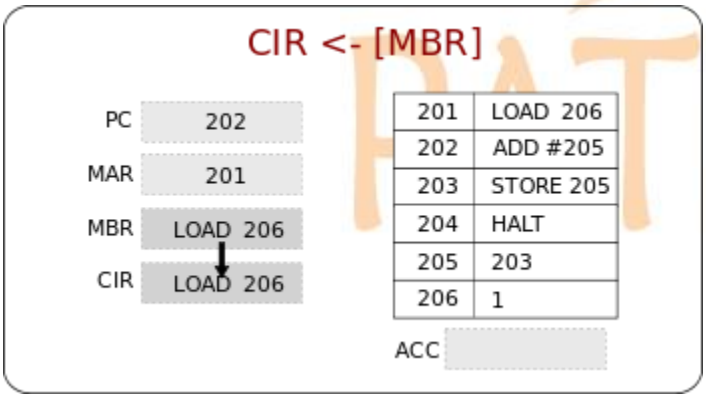
To better understand what is going on at each stage we'll now look at a detailed description:



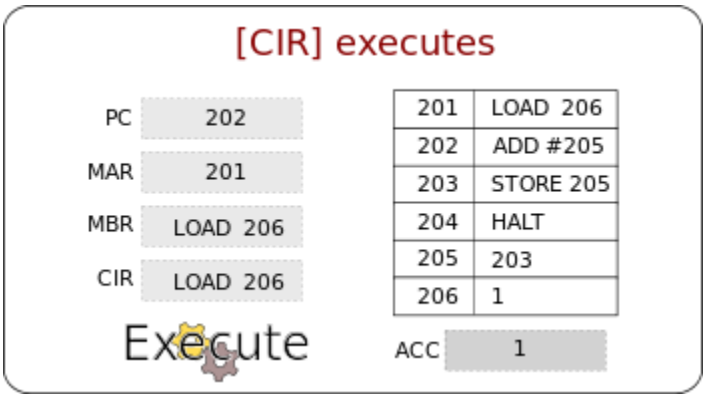
The contents of the Program Counter, the address of the next instruction to be executed, is placed into the Memory Address Register



The address is sent from the MAR along the address bus to the Main Memory. The instruction at that address is found and returned along the data bus to the Memory Buffer Register. At the same time the contents of the Program Counter is increased by 1, to reference the next instruction to be executed.



The MBR loads the Current Instruction Register with the instruction to be decoded by decoder of control unit or the MBR loads Accumulator with the data to be executed.

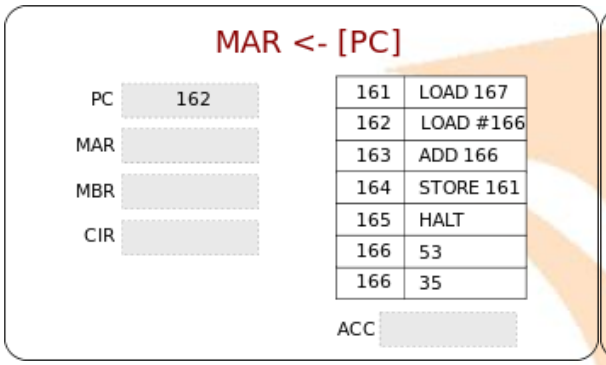


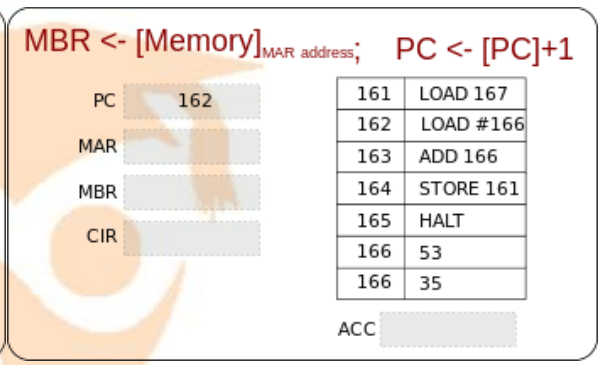
The instruction is decoded and executed using the ALU if necessary.

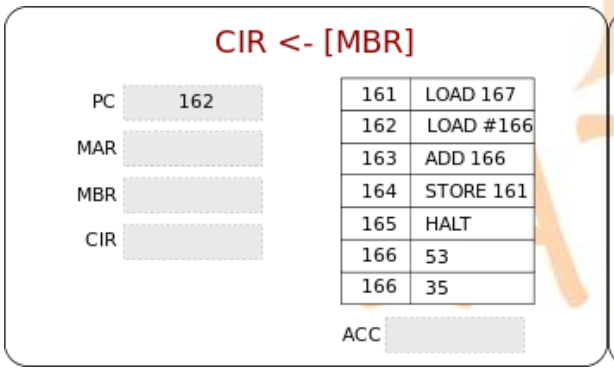
The Cycle starts again!

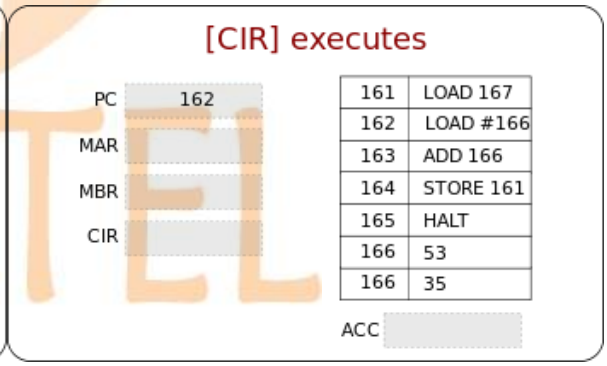
Activity

Complete the following diagrams showing each step of the fetch decode execute cycle:









Examination Questions

Q1) Describe what differs a computer with a calculator

....

.... **[1]**

Q2) Differentiate an ALU with a calculator.

....

.... **[1]**

Q3) Von Neumann gave the idea how computer should be built.

a) Describe the purpose of each of the following parts of a processor:

(i) Control unit

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....
.... **[1]**

(ii) Arithmetic & Logic unit

....
.... **[1]**

(iii) Register

....
.... **[1]**

b) Draw and label the diagram of von Neumann architecture.

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Q4) Draw the diagram and describe the stages of fetch-execute cycle.

.....
.....
.....
.....
.....
..... **[6]**

Q5) Jo buys a notebook computer which has a 3MHz quad-core central processing unit (CPU).

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(a) State the purpose of the CPU.

....

.... **[1]**

(b) Describe what is meant by

3MHz CPU

.....

.....

..... **[2]**

quad-core CPU

.....

.....

..... **[2]**

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Q6) (9693_13w_q12)

There are 4 processor component terms on the left and 10 descriptions of functions on the right. Draw a line connecting each description to the correct component.

	Manages execution of instructions
ALU	Carries out arithmetic operations such as addition and multiplication
	Fetches each instruction in turn
Control unit	Stores program in current use
	Carries out bit shifting operations
	Stores boot-strap loader
RAM	Carries out operations such as AND, OR, NOT
	Issues timing signals
ROM	Stores part of operating system in current use
	Stores data in current use

[10]

Q 7) Name 3 registers involved in the Fetch Execute Cycle and describe what each does:

1. .....
   .....
2. .....
   .....
3. .....
   ..... [3]

Q8) Describe the purpose of the following registers in a processor:

(i) Program Counter (Sequence Control Register).

.....

..... **[1]**

(ii) Current Instruction Register.

.....

..... **[1]**

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(iii) Memory Address Register.

.....

..... **[1]**

(iv) Memory Data Register.

.....

..... **[1]**

(v) Accumulator

.....

..... **[1]**

Q9) Describe two stages of the fetch/execute cycle which would change the contents of the MAR. State clearly, in each case, what the MAR contains.

.....

..... **[2]**

Q10)(i) State what is held in the Program Counter (PC) during the fetch/execute cycle.

.....

..... **[1]**

(ii) Explain how the contents of the PC change during the fetch/execute cycle.

.....

..... **[1]**

Q11)(b) At a particular point in a program, the program counter (PC) contains the value 200.State the expected value contained in the PC after the instruction held at location 200 has been fetched. Explain your answer.

.....

..... **[1]**

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Marking Scheme

Q5)

a)To carry out the processing on the computer/To (fetch and) execute instructions'

b) 3MHz. Two from

3MHz is the clock speed / how fast the processor is

Indicates how many instructions may be processed in each second

Indicates how many clock cycles per second

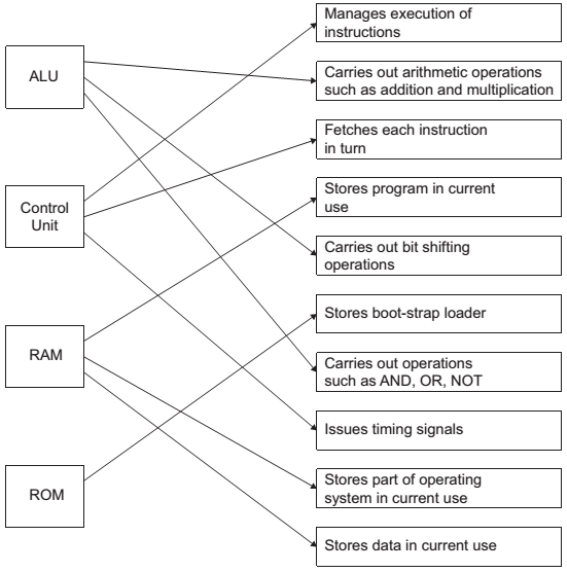
c) Quad core

The computer has 4 cores...

…which are independent processors within the CPU ..

... working simultaneously / can perform multiple tasks

Q6)



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1.3.3 & 1.3.4 Input & Output Devices

1.3.3 Input devices
• describe the principles of operation (how each device works) of a range of input devices including 2D and 3D scanners, barcode readers, digital cameras, keyboards, mice, touch screens, microphones
• describe how these principles are applied to real-life scenarios, for example: scanning of passports at airports, barcode readers at supermarket checkouts, and touch screens on mobile devices
• describe how a range of sensors can be used to input data into a computer system, including light, temperature, magnetic field, gas, pressure, moisture, humidity, pH/acidity/alkalinity and motion/infra-red
• describe how these sensors are used in real-life scenarios, for example: street lights, security devices, pollution control, games, and household and industrial applications
1.3.4 Output devices
• describe the principles of operation of a range of output devices, including: inkjet, laser and 3D printers; 2D and 3D cutters; speakers and headphones; actuators; flat-panel display screens, including Liquid Crystal Display (LCD) and Light-Emitting Diodes (LED); and LCD projectors and Digital Light Projectors (DLP)
• describe how these principles are applied to real-life scenarios for example: printing single items on demand or in large volumes; banks of digital displays; use of small screens on mobile devices; smart boards

Input Devices:

Input devices allow us to enter raw data into a computer. The computer processes the data and then produces outputs that we can understand using an output device. Input devices can be manual or automatic.

There are two different categories of input device. They are:

- **Manual Input Devices** : With a manual input device the user must enter data into the computer by hand. e.g. mouse, keyboard, scanner.
- **Direct Data Entry (DDE) Devices** : A direct data entry device can transfer information automatically from a source document such as a form or barcode into the computer. The user does not need to manually enter the information. e.g. optical mark recognition, smart cards.

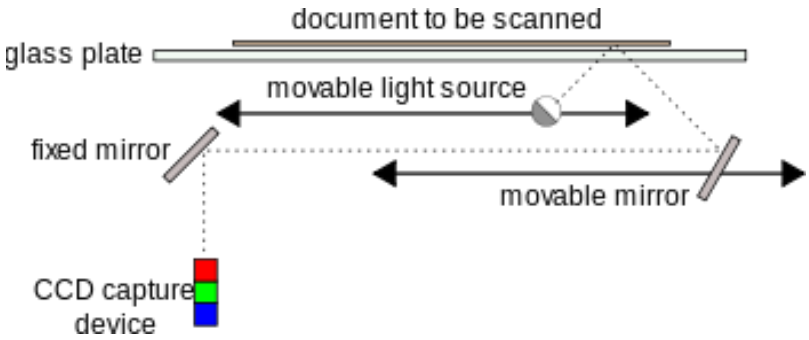
There are many different input devices available. Each input device is suitable for a different purpose. Below you will find descriptions of the most common manual input and direct data entry devices.

Manual Input Devices

With a manual input device the user must enter data into the computer by hand. e.g. mouse, keyboard, scanner.

Two-dimensional scanners

2D scanner or an **image scanner**—often abbreviated to just **scanner**, is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image. The image is converted into an electronic form which can be stored in a computer.



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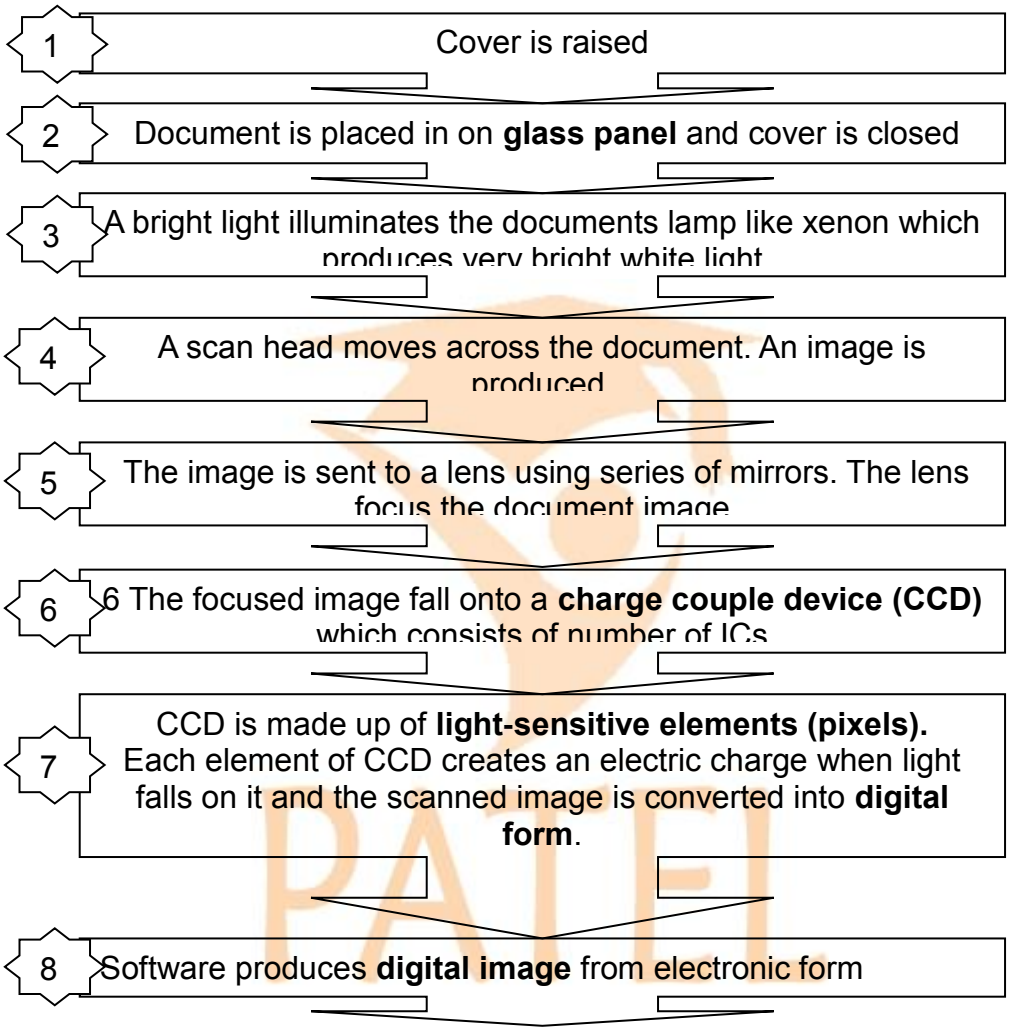
Commonly used in offices are variations of the desktop flatbed scanner where the document is placed on a glass window for scanning.
Modern scanners typically use a charge-coupled device (CCD) or a contact image sensor (CIS) as the image sensor
"A flatbed scanner is usually composed of a glass pane (or platen), under which there is a bright light (often xenon, LED or cold cathode fluorescent) which illuminates the pane, and a moving optical array in CCD scanning. CCD-type scanners typically contain three rows (arrays) of sensors with red, green, and blue filters."



Example Question 1) The seven stages in scanning a document are shown in the table below.
Put each stage in the correct sequence by writing the numbers 1 to 8 in the left hand column.
The first one has been done for you. Write down the steps

	The focused image fall onto a **charge couple device (CCD)** which consists of number of ICs
	Document is placed in on **glass panel** and cover is closed
	Software produces **digital image** from electronic form
	CCD is made up of **light-sensitive elements (pixels).** Each element of CCD creates an electric charge when light falls on it and the scanned image is converted into **digital form**.

	The image is sent to a lens using series of mirrors. The lens focuses the document image.
1	Cover is raised
	A scan head moves across the document. An image is produced.
	A bright light illuminates the documents lamp like xenon which produce very bright white light

Optical character recognition (optical character reader) (**OCR**) is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text.

It is widely used as a form of data entry from printed paper data records, whether passport documents, invoices, bank statements, computerized receipts, business cards, mail, printouts of static-data, or any suitable documentation.

Scanner scans the document and then OCR converts it into machine readable form.

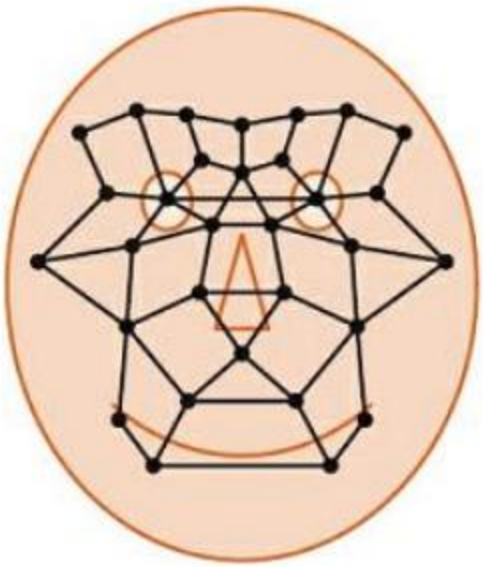
Application of 2D scanners at an airport

Passengers fly into an airport from other countries. The airport has a security system that uses:

- computers
- scanners
- digital cameras

To gain entry to the country, each passenger must have a passport or identification (ID) card. This must contain a recent photograph and other personal data.

- Passport or ID card is placed on a scanner that reads machine-readable characters and scans the photograph
- Camera takes an image of the passenger's face
- Facial recognition software/ biometric software used to scan face
- Face image converted to digital format/ data by the camera
- Digital image formed from scanned photo/ biometric data stored in passport
- Key features of the face are checked/ compared



The face shows several of the positions used by the face recognition software. Each position is checked when the software tries to compare two facial images.

Data such as:

- distance between the eyes
- width of the nose
- shape of the cheek bones
- length of the jaw line
- shape of the eyebrows

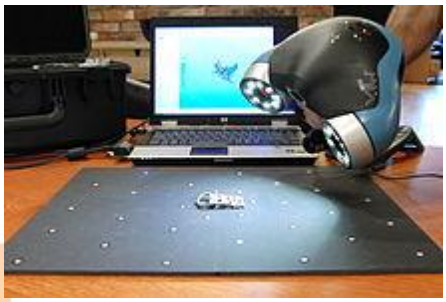
are all used to identify a given face.

When the image from the passport and the image taken by the camera are compared, these key positions on the face determine whether

or not the two images represent the same face.

Example Question:
Passengers fly into an airport from other countries. The airport has a security system that uses:
• computers
• scanners
• digital cameras
To gain entry to the country, each passenger must have a passport or identification (ID) card. This must contain a recent photograph and other personal data. The passenger must:
• place their passport or ID card on a scanner that reads machine-readable characters and scans the photograph
• look towards a camera that takes an image of the passenger's face
Describe how a computer checks whether the image just taken by the camera matches the scanned photograph.
.....
.....
.....
.....
.....[2]

Three-dimensional scanners:
A **3D scanner** is a device that analyses a real-world object or environment to collect data on its shape and possibly its appearance. Since real-world objects have *x*, *y* and *z* coordinates, these scanners take images at several points along these three coordinates. A digital image which represents the solid object is formed. The collected data can then be used to construct digital three-dimensional models.



Application of 3D scanning – computed tomographic (CT) scanners
COMPUTED TOMOGRAPHIC (CT) SCANNERS are used to create a 3D image of a solid object. This is based on **TOMOGRAPHY** technology which basically builds up an image of the solid object through a series of very thin 'slices'. Together these 2D'slices' make up a representation of the 3D solid object. Each slice is built up by use of X-rays, radio frequencies or gamma imaging;
although a number of other methods exist. Each 'slice' is then stored as a digital image in the computer memory. The whole of the solid object is represented digitally in the computer memory.
Depending on how the image is formed, the type of tomographic scanner can have different names. For example:
- X-rays CT scanners computerised tomography
- radio frequencies MRI magnetic resonance imaging
- gamma rays SPECT single photon emission computed tomography.

Bar Code Reader/Scanner
A **barcode** is an optical machine-readable representation of data relating to the object to which it is attached in the form of a series of dark

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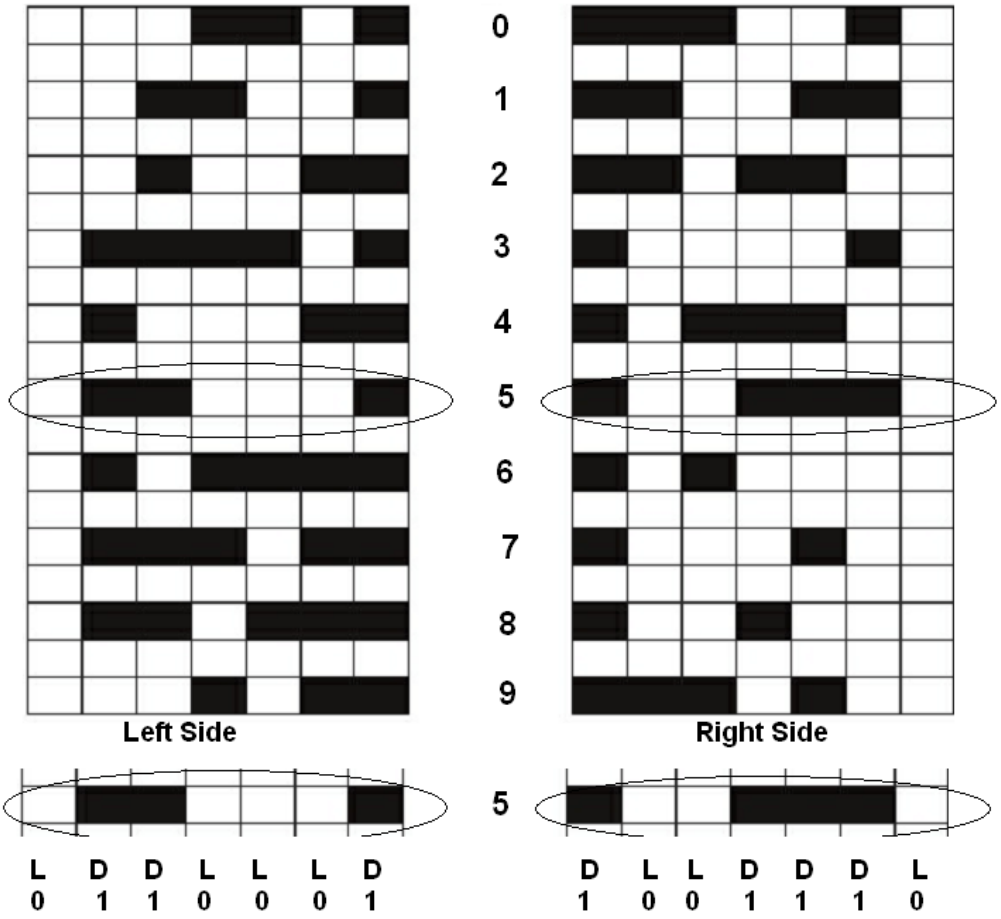
and light parallel lines of varying thickness.
The mapping between messages and barcodes is called a *symbology* e.g. code 39, UPC (universal product code) etc.

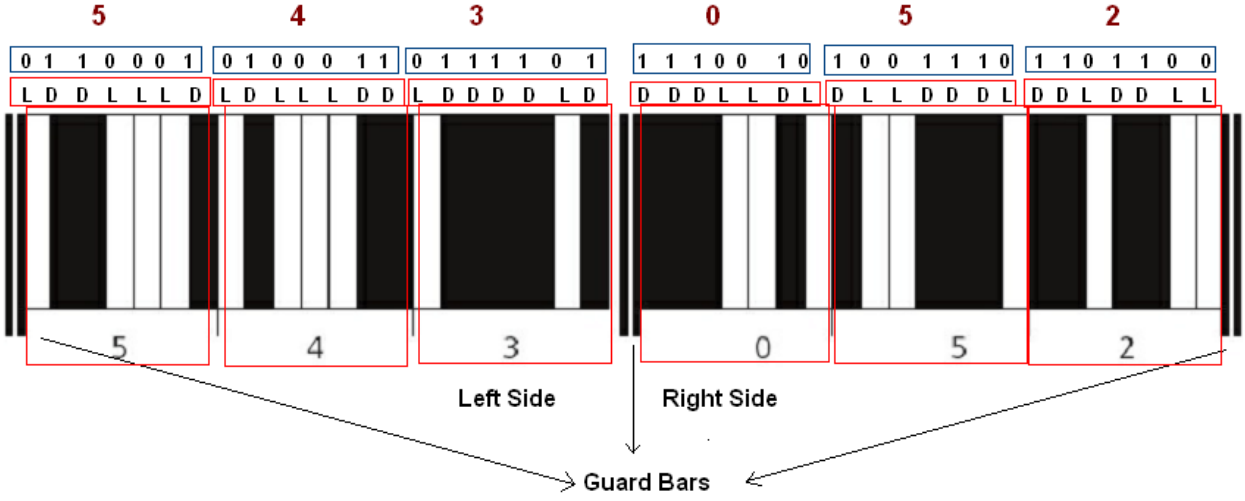
In UPC (Universal Product Code) the actual left-hand and right-hand sides of the barcode are separated using guard bars. The structure of these guard bars is shown in is an example of a barcode showing the left-hand side and right-hand side and the three sets of guard bars.
Dark lines of bar codes are represented by bit 1 and light lines are represented by bit 0.
7 bits make a digit using different coding method for left and right sides.



Means at left side 0110001=5 while on right side 1001110=5

Similarly left side 0100011=4 while on right side 1011100=4

same method will be used for 3 0 and 2 for following bar code:



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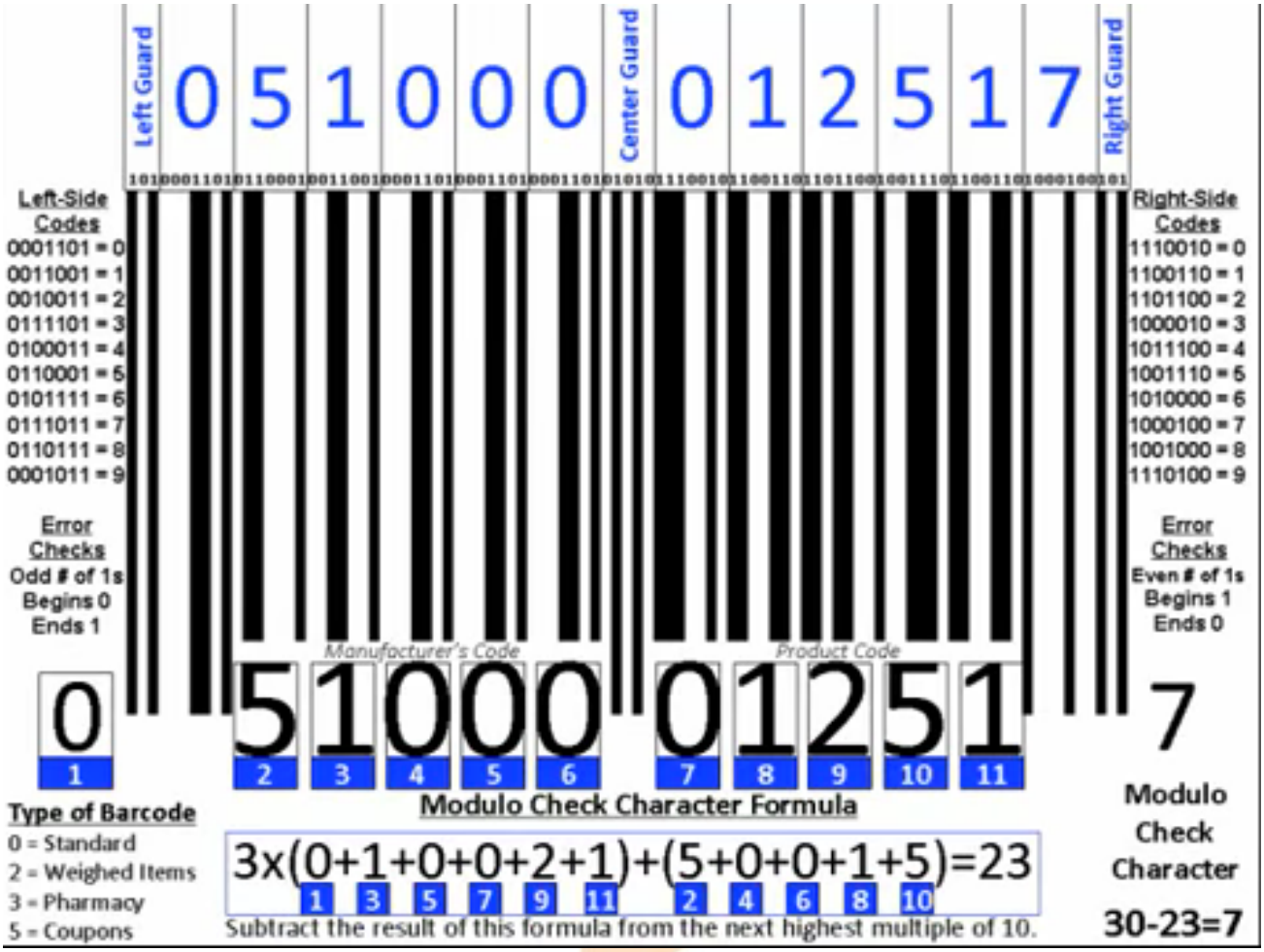


1. The barcode is first read by a red laser or red **LED (LIGHT EMITTING DIODE)**.
2. Light is reflected back off the barcode; the dark areas reflect little or no light which allows the bars to be read
3. The reflected light is read by sensors (photoelectric cells).
4. As the laser or LED light is scanned across the barcode, a pattern is generated which is converted into digital data – this allows the computer to understand the barcode.
5. For example: the digit '3' on the left generates the pattern **L D DDD L D** (whereL = light and D = dark); this has the binary equivalent of **0 1 1 1 1 0 1** (where **L =0** and **D = 1**
6. If barcode are not scanned correctly the bar code number is types in manually using keyboard

Quick response (QR) codes

QR code (abbreviated from **Quick Response Code**) is the trademark for a type of matrix barcode (or two-dimensional barcode) first designed for the automotive industry in Japan.

A barcode is a machine-readable optical label that contains information about the item to which it is attached. A QR code uses four standardized encoding modes (numeric, alphanumeric, byte/binary, and kanji) to efficiently store data; extensions may also be used.

A bar code can store up to 30 characters while in QR code 7000 digits can be stored.

The following QR Code at left stores web address http://www.ruknuddin.com while QR Code at right stores contact information of Inqilab Patel

Because of modern smart phones, which allow internet access on the move, QR codes can be scanned anywhere. This allows advertising of products on trains, buses, shopping malls and many other places. By using the built-in camera facility on modern phones and downloading the appropriate application (or app), it is possible to read the QR code. The code may contain a website link or some form of advertising (e.g. special offers on pizzas).

On scanning the QR code, the phone number and advertisement will appear on the mobile phone's screen. Advantages of QR codes include:

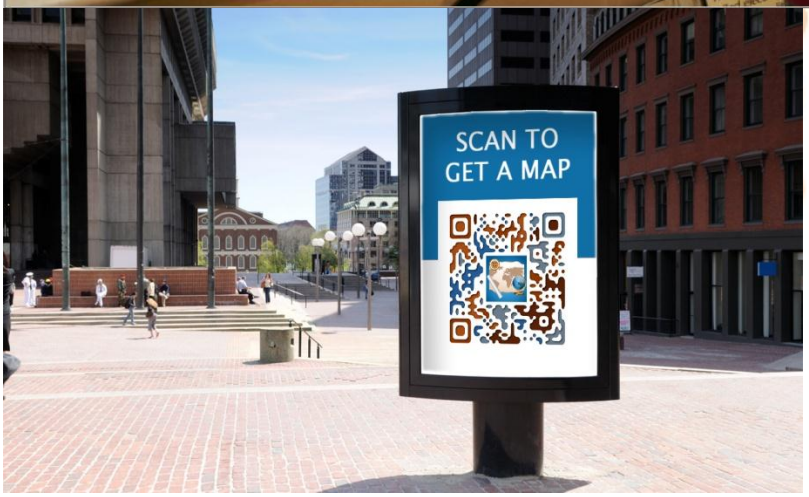
- there is no need for the user to write down or key in a website address; scanning the QR code does this automatically
- QR codes can store website addresses/URLs that appear in magazines, trains, buses or even on business cards, giving a very effective method of advertising.

How you can use QR codes

Here are 5 ways you can use QR codes for your organization's sales and marketing efforts.

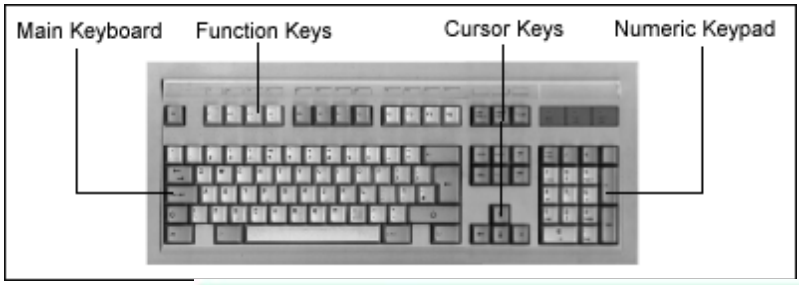
1. **Add QR codes to your business cards.** You can include your business name and address, website, blog, or even links to your social media properties. The QR code will let your prospects and peers scan your business card and easily add you to their contacts.

2. **Include QR codes in your print advertising.** You can link prospects to product videos, spec sheets, or “Buy Now” pages. Assigning a URL specific to the QR code in the ad with a re-direct is a great way to track how much traffic came to that page through your print advertisement.
3. **Create a campaign to increase your social following.** Include a QR code to instantly link to your Facebook, Twitter, or LinkedIn page on print advertisements, direct mail pieces, or even your email signature.
4. **Add QR codes to your product packaging** and link customers to a page with useful resources – like customer service phone numbers, user manuals, and related items.
5. **Use QR codes for company or customer-facing events.** Add a QR code to an event ticket and link to a Google map, and RSVP page, or materials that attendees need to bring along.



Keyboard

A keyboard is the set of typewriter-like keys that enables user to enter data into a computer.



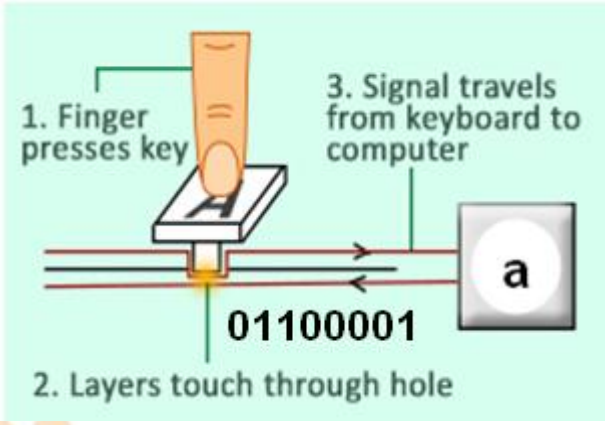
How keyboard works

Each individual key is a switch.

When a key is pressed it generates a specific binary code, based on ASCII.

For example:

- Pressing **A** key produces binary code 01100001, representing lower case letter **a**,
- This binary code is sent to processor.



So processor recognises which key is pressed

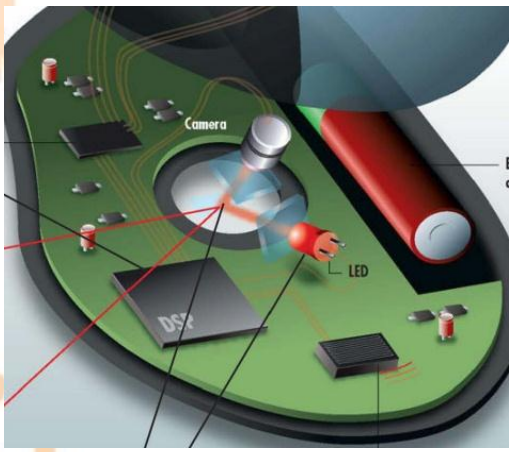
Advantages of using keyboards for data input include

Entering data and instructions with keyboards is generally faster than with pointing devices.

Disadvantages of using keyboards for data input include

It takes a lot of time to practice in order to type quickly and accurately.

Typing speeds are still very slow when compared with computer speeds.



Mouse

A mouse is the most common **pointing device**. You move the mouse around on a mat and a small cursor called a **pointer** follows your movements on the computer screen. By pressing a button on the mouse (most mice have 1,2 or 3 buttons) you can select options using icons or menus on the screen. Mice can also be used to "draw" onto the screen. They are particularly useful if your computer has a graphical user interface.

Principle of operation of laser mouse:

S No	Step
1	laser/light shines onto a surface through a (polished) ring at the base
2	the light is reflected from the surface through the ring
3	sensor detects reflected light
4	capturing details/photograph of surface (under the ring) at about 1500 times per second
5	as the mouse moves the sensor detects changes in the surface detail/photograph
6	These changes are translated into movement (change of x and y co-ordinates)
7	the computer/software updates the position of the cursor on the screen

Advantages of using a mouse include

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A mouse is user-friendly for computer beginners.
A mouse is easy and convenient to use with a graphical user interface.
Using a mouse to select items or move to a particular position on the screen is faster than using a keyboard.

Disadvantages of using a mouse include

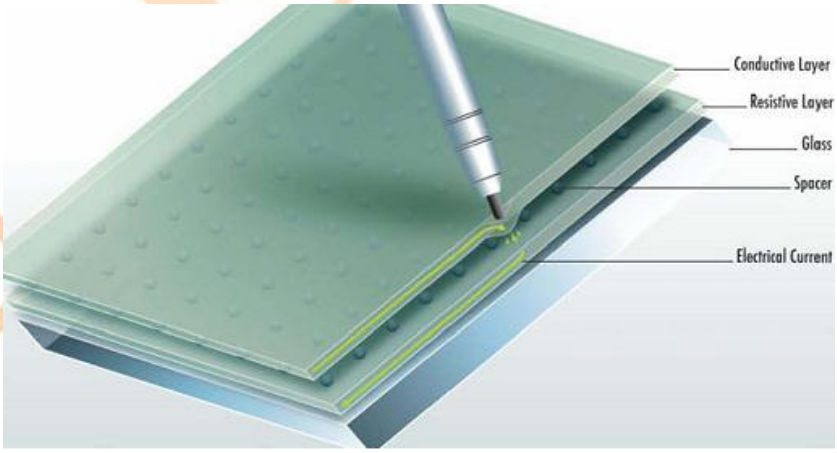
It is not easy and convenient to input text with a mouse.
Issuing commands by using a mouse is slower than by using a keyboard.
A mouse is not accurate enough for drawings that require high precision.
A mouse usually requires a flat surface to operate.
A mouse needs more desk space to operate when compared with a trackball.

Touch Sensitive Screens

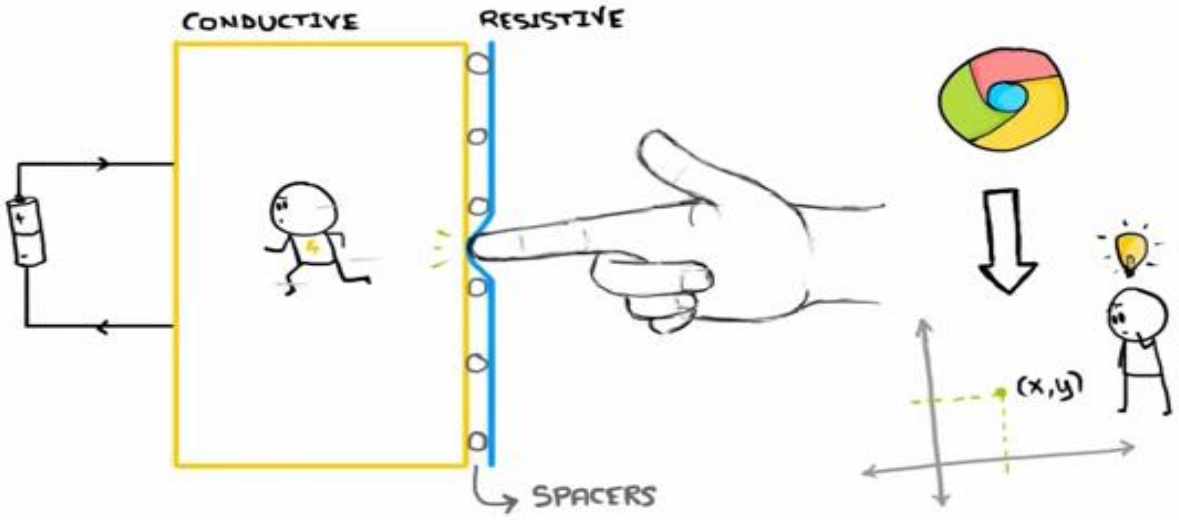
Only items already on the screen can be selected.
The majority of mobile phones use touch screens.
Three common technologies are used by different mobile phone manufacturers.

Resistive

The screen on a tablet PC using the resistive system includes a glass panel covered with a thin metallic layer made of a substance, such as indium tin oxide, that conducts electricity.



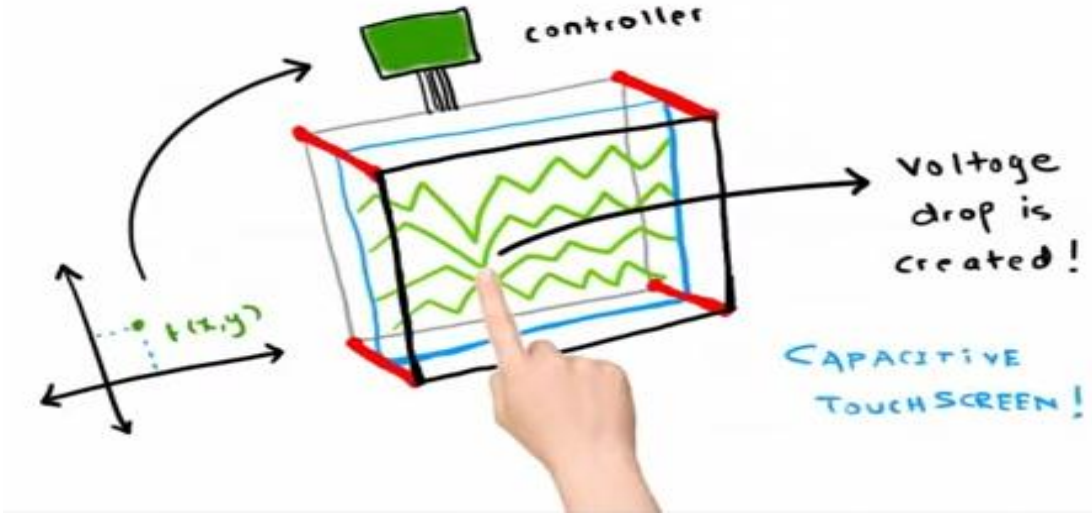
Spacers on the layer support a metallic layer that resists the flow of electricity.
When you touch the screen with your finger or a stylus, the two layers make contact, changing the electrical field produced by the layers. This permits the computer to calculate the coordinates of the contact.

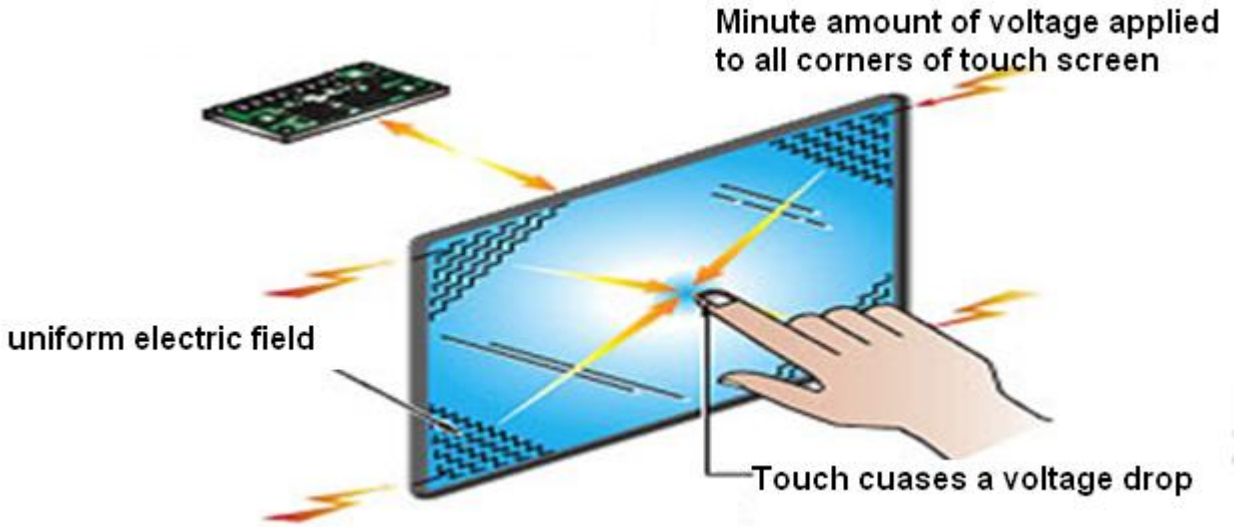


Benefits	Drawbacks
− inexpensive/cheap to manufacture − can use stylus/finger/gloved finger/pen	− poor visibility in sunlight − vulnerable to scratching − wears through time − does not allow multi-touch facility

Capacitive

In a **capacitive system,** a transparent material that stares an electrical charge covers the screen's glass panel. When you touch the monitor, some of the charge is transferred to your finger and the capacitive layer's charge decreases. Circuits at each corner of the screen constantly measure the change in the charge reaching them. From those measurements, the computer calculates where the touch occurred.



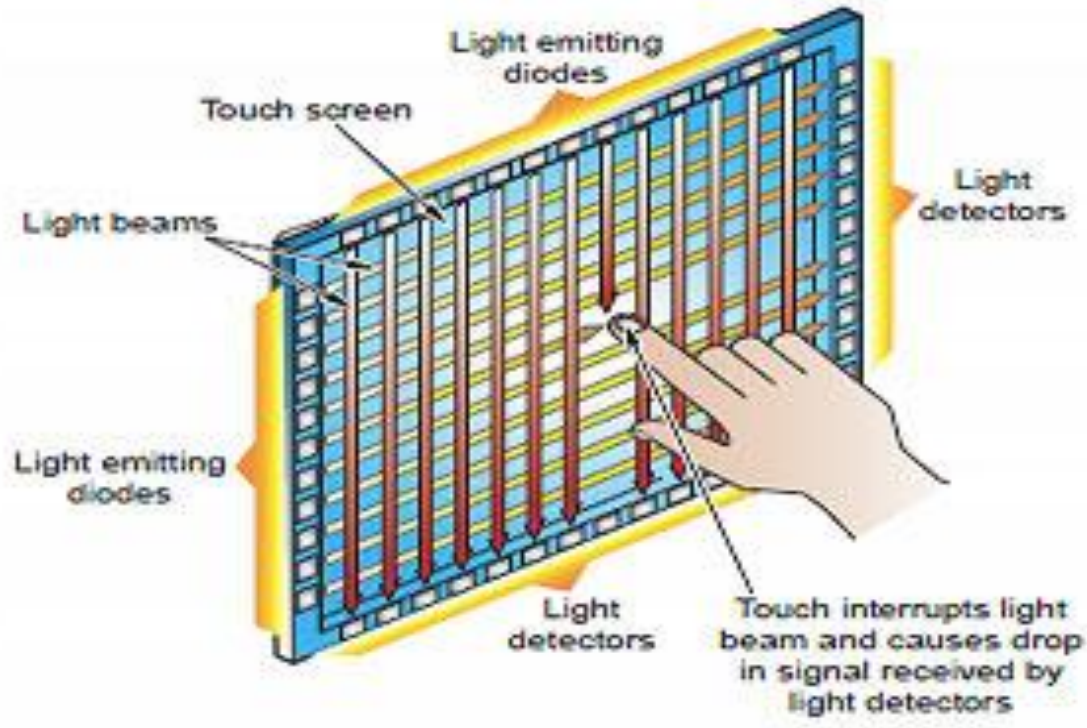


Benefits	Drawbacks
− *good visibility in sunlight* − *(very) durable surface* − *allows multi-touch facility*	− *screen (glass) will shatter/break/crack (on impact)* − *cannot use when wearing (standard) gloves*

Infra-Red

Infrared touch screens are based on light-beam interruption technology. Instead of an overlay on the surface, a frame surrounds the display. The frame has light sources, or light emitting diodes (LEDs) on one side and light detectors on the opposite side, creating an optical grid across the screen.

When an object touches the screen, the invisible light beam is interrupted, causing a drop in the signal received by the photo sensors.



Benefits	Drawbacks
good durability allows multi-touch facility can use stylus/finger/gloved finger/pen 100% light transmission (not an overlay) Accurate	− expensive to manufacture − screen (glass) will shatter/break/crack (on impact) − sensitive to dust/dirt No protection for display surface

Digital Cameras

Digital cameras are used in the same way as standard photographic cameras. Most digital cameras look just like ordinary cameras. Unlike photographic cameras digital cameras do not use film. Inside a digital camera is an array of light sensors. When a picture is taken the array of sensors is used to input the image. The image can then be stored either in the camera's RAM or on a floppy disk. Later the pictures can be transferred onto a computer for editing using a graphics package.

Some digital cameras are available relatively cheaply, for about £300. However these cameras do not take very good pictures. More expensive cameras can take higher quality pictures but these are still not quite as good as standard photographs. Digital cameras are extremely useful for tasks such as producing newsletters.

Video Digitiser

A video digitiser takes an image from a video camera or television and converts it so that it can used by and stored on a computer. Almost all video digitisers now work in colour. Unlike scanners video digitisers can capture **moving video sequences** as well as still images. When a video sequence is captured the computer stores this as a sequence of still images called **frames**. These images are displayed quickly one after the other (rather like a flick-book) to create the illusion of a moving picture.

When you want to capture a video sequence you must tell the computer:

- **Size**: How big you want the image you capture to be. e.g. should it take up the whole screen, 1/2 the screen, 1/8th of the screen ... ?
- **Frame Rate** : How frequently the frames should be captured from the video.

If you want to capture large images you may have to settle for a slow frame rate which will make the captured video film look jittery. If you want a fast frame rate you may only be able to capture a small image size. Video sequences captured using a video digitizer is often used in multimedia presentations.

Voice Recognition

Voice recognition systems listen to what people are saying and carry out the instructions given to them when people speak.

Automatic Data Capture Devices

Direct data entry devices are used when large volumes of data must be entered into the computer quickly without human involvement.

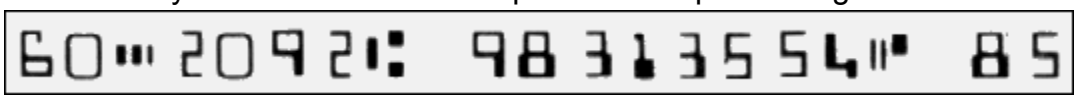
Magnetic Stripe Reader

Magnetic stripes are built into many plastic cards such as cheque guarantee or credit cards.

To be read the card is swiped through a machine which quickly and accurately reads the pattern of magnetism.

Magnetic Ink Character Recognition (MICR)

The MICR system reads characters printed in a special magnetic ink on bank cheques.

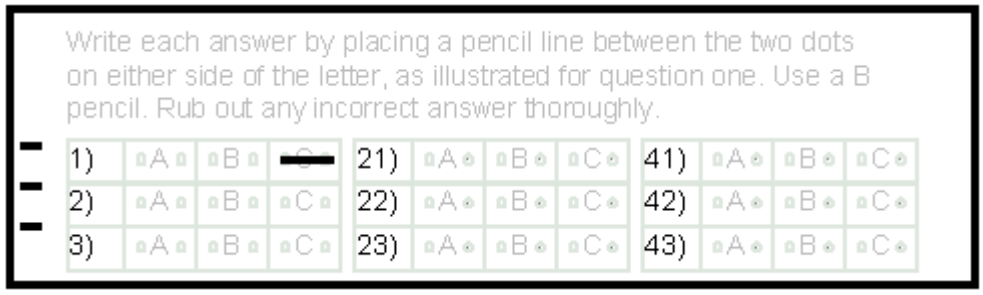


The information printed on the cheque using MICR is :

- A unique number for the cheque.
- A code that identifies the bank and branch that issued the cheque.
- The number of the account that the cheque relates to.

Optical Mark Recognition (OMR)

An optical mark reader reads marks made by pencil on a printed form into the computer. OMR systems are used by examination boards to collect the answers to multiple choice examinations and to purchase lottery tickets. Here is an example answer grid for an examination:



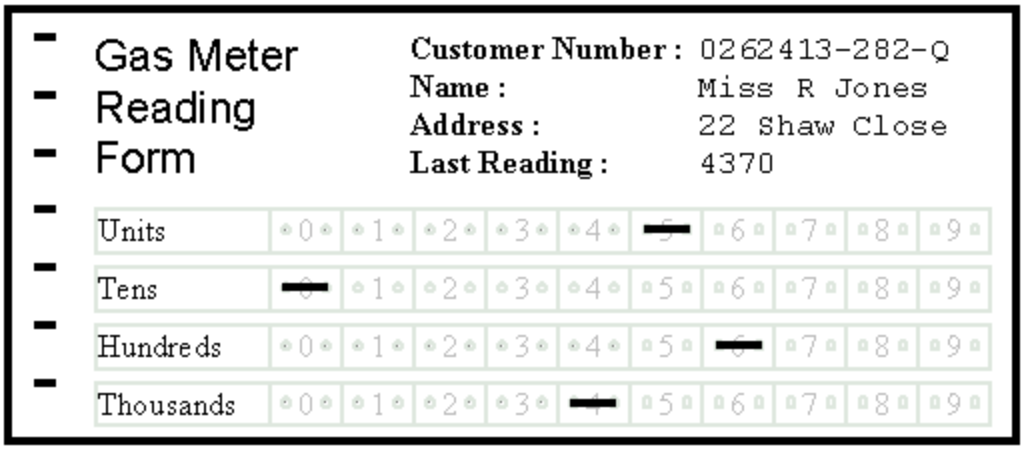
Turnaround Documents

Optical mark recognition and optical character recognition are often used together in a turnaround document. A **turnaround document** is a document which:

- Has some information printed onto it by a computer?
- Has more information added to it by a human?

Is fed back into a computer to transfer the added information into the computer.

Here is a turnaround document that a gas company could use to record meter readings.



Sensors

Sensors can be used to measure physical quantities such as temperature, light and

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pressure. The measurements can then be stored for later use (data logging) or used to control devices such as heaters or fans (computer control).

Try yourself 2):

Name each input device described below:

It reads parallel dark and light lines which represent a string of characters. .....

Used for entry of numbers and arithmetic symbols only. .....

Users select options by simply making finger contact with its surface. .....

It has buttons to make selections and a small wheel to allow scrolling. ..... [4]

Summary of Input Devices

Device	Use
Keyboard	Entering text into a word processing document. Applications where text has to be created rather than copied
Numeric keypad	Applications where only numeric data is to be entered. Inserting personal identification number (PIN) for Chip and PIN credit/debit cards, or when using an ATM machine to withdraw money or check a bank balance
Pointing devices – all	All applications which require selection from a graphical user interface. For example: the selection of data from a set list or menu
Mouse	In most PCs
Touch pad	On laptop computers
Tracker ball	For use by people with limited motor skills e.g. young children or people with disabilities
Remote control	Using remote control devices to operate TVs, video players/recorders, DVD players/recorders, satellite receivers, HiFi music systems, data or multimedia projectors
Joystick	Used by a pilot to fly an aeroplane or flight simulator. Used in car driving simulators and for playing games
Touch screen	Selecting from a limited list of options e.g. certain POS uses such as cafes, tourist information kiosks, public transport enquiries
Magnetic stripe readers	At POS terminals, ATMs and in security applications
Chip readers and PIN pads	Payment cards, ID cards, door control systems, public transport tickets
Scanners	Entering hard copy images into a computer
Digital cameras	Taking photographs for input to computers, for input to photo printers
Microphones	Recording of voices for presentation software

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Output Devices

An **output device** is any piece of computer hardware equipment used to communicate the results of data processing carried out by an information processing system (such as a computer) which converts the electronically generated information into human-readable form.

Soft Copy: The output displayed on screen or stored in storage devices is soft copy.

Hard Copy: The output printed on paper is hardcopy output.

CRT Monitor

A monitor displays **text** and **image** data passed to it by the computer.

A **cathode-ray tube** (CRT) monitor is the type that has been around for years and is **large** and **boxy**.

CRT monitors are **heavy** and they take up a **lot of desk space**. They have largely been **replaced** by flat-screen monitors. However some are still used in the design industry since the **colour accuracy** and **brightness** of CRT monitors is excellent, and designers need to see true-to-life colours.

Also, CRT monitors are generally **cheaper** than flat-screen monitors.

Flat-Screen Monitor (TFT or LCD)

Over the past few years, as they have come down in price, flat-screen displays have **replaced** CRT monitors.

Flat-screen monitors are **light in weight** and they take up very **little desk space**.

Modern flat-screen monitors have a **picture quality** that is as good as CRT monitors.

Digital / Multimedia Projector

Digital projectors are used in situations when a **very large viewing area** is required, for example during **presentations**, for **advertising**, or in your home for **watching movies**.

A projector connects to a **computer**, a **DVD player** or a **satellite receiver** just like an ordinary monitor.

The image is produced inside the device and then projected out through a large lens, using a **powerful light source**.

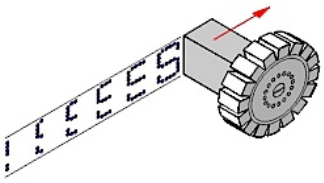
Loudspeaker

If you want to hear **music** or **sounds** from your computer, you will have to attach loudspeakers. They convert electrical signals into **sound waves**.

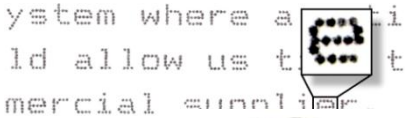
Loudspeakers are essential for applications such as **music editing**, **video conferencing**, watching **movies**, etc.

Dot Matrix Printer

A dot-matrix printer is named after the pattern (a grid or 'matrix') of dots used when creating the paper printout.



These dots are formed by tiny **pins** in the printer's print head that **hit** an inked ribbon against the paper leaving marks. As the print head moves along it leaves a pattern of **dots** behind it which can form letters, images, etc.



Dot matrix printers often use **continuous stationary**: long, continuous strips of paper (rather than separate sheets of A4 like ink-jet and laser printers use).

After printing, the printout is torn off from the long strip.

Dot-matrix print **quality is poor**, the printers are **noisy**, and there are much better printing systems available today. However, the dot-matrix printers are still used in certain situations:

- Since the pins actually hit the paper, several '**carbon-copies**' can be printed in one go. An example of this is **airline tickets** which have several **duplicate pages**, all printed in **one go**
- The print mechanism is **very cheap**, and the inked ribbons last for a **long time**.

So, where cheap, low-quality printouts are required, dot-matrix printers are used. An example is **shop receipts**.

Inkjet Printer

Inkjet printers have a similar print-head mechanism to a dot-matrix printer. The print-head passes left and right across the paper. However, instead of using pins to hit inky marks onto the paper, the ink-jet **squirts** tiny **droplets** of ink onto the surface of the paper. Several coloured inks can be used to produce **full-colour** printouts

How inkjet printers work:

S No	Step
1	Printer driver translates data into a suitable format for the printer
2	Printer receives data from the computer and stores the data in the printer's buffer
3	Paper feed stepper motor activated; sheet of paper fed from paper tray
4	The print head moves across page; ink is sprayed each time the print head pauses for a fraction of a second
5	Paper feed stepper motor advances paper a fraction of a cm after each complete head pass

Laser Printer

Laser printers are very **complex** devices, and thus **expensive to buy**. However they are very **cheap to use**. This is because they produce marks on paper using a fine dust called **toner** which is relatively cheap to buy. A single toner cartridge will often last for 5,000-10,000 pages of printing.

The laser printer uses a complex system, involving a **laser**, to make the toner stick to the required parts of the paper. (This system is very different to a dot-matrix or ink-jet, and you don't need to know the details.)

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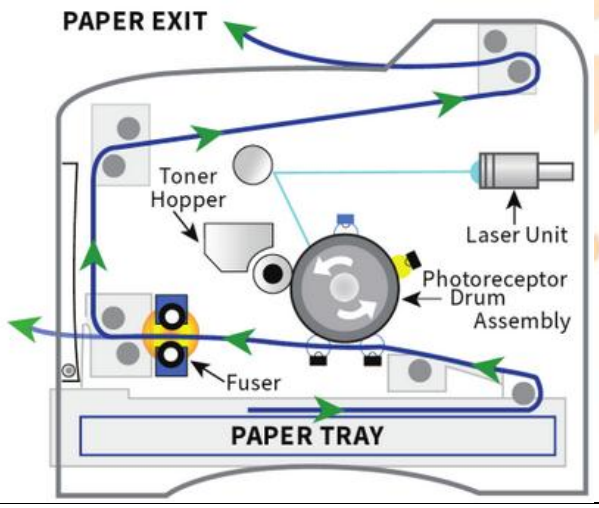
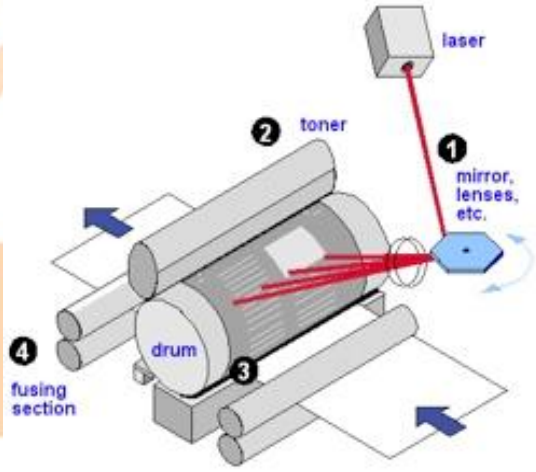
The laser and toner system allows **very fast printing** compared to other printers (just a few seconds per page).
Laser printers are very common in **offices** since they print very quickly, are cheap to use and are reasonably quiet.

S No	Step
1	The printer driver ensures that the data is in a format that the laser printer can understand
2	Data is then sent to the laser printer and stored temporarily in the printer buffer
3	The printing drum is given a positive charge
4	As the printing drum rotates, a laser scans across it; this removes the positive charge in certain areas
5	Negatively-charged areas are then produced on the printing drum; these match exactly with the text and images to be printed
6	The printing drum is coated in positively-charged toner; this then sticks to the negatively-charged parts of the printing drum
7	A negatively-charged sheet of paper is then rolled over the printing drum
8	The toner on the printing drum is now transferred to the paper to reproduce the required text and images
9	The paper goes through a fuser which melts the toner so it fixes permanently to the paper





Plotter
Plotters create hard-copy in a very different way to printers. Instead of building up text and images from tiny dots, plotters **draw** on the paper using a **pen**.

The pens are held in an arm which can lift the pen up or down, and which can move across the paper. The arm and pen create a drawing just like a human could, but much more **accurately** and more **quickly**.

Different **coloured pens** can be used to produce coloured line drawings.

Plotters are often used by **designers** and **architects** since they work with **huge pieces**

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of paper, far bigger than anything a normal printer could work with...

*Plotters are only suitable for producing **line drawings**. They cannot produce the kind of text and images that an ink-jet or laser printer could. (So you cannot use a plotter to produce photos for example)*
Plotters have been largely superseded by large-format ink jet printers that can produce more detailed printouts and in full-colour

Example Question 3)
(a) (i) Choose between:
laser printer / inkjet printer *(circle your choice)*
Describe **one** feature and **one** drawback of your chosen type of printer.
Feature .....
.....
Drawback .....
.....[2]
(ii) Choose between:
3D printer / graph plotter *(circle your choice)*
Describe **one** feature and **one** drawback of your chosen device.
Feature .....
.....
Drawback .....
.....[2]

3D Printer

Summary of output devices

Device	Use
CRT monitor	Applications where space is not a problem. Applications where more than one user may need to view screen simultaneously such as in design use, e.g. when several designers may need to offer suggestions on a prototype
TFT monitor	A **thin-film-transistor** liquid-crystal **display** (**TFT**LCD) is a variant of a liquid-crystal **display** (LCD) that uses **thin-film transistor** (**TFT**) technology to improve image qualities such as addressability and contrast. Applications where space is limited such as small offices. Applications where only one person needs to view the screen such as individual workstations
Multimedia Projector	Applications such as training presentations, advertising presentations and home cinema – it displays data from computers, pictures from televisions and video/DVD recorders
Laser printer	Applications which require low noise and low chemical emissions, e.g. most networked systems. Applications which require rapid, high quality and high volumes of output, e.g. most offices and schools
Inkjet printer	Applications which require portability and low volume output, where changing cartridges is not an issue e.g. small offices and stand alone systems. Applications which require very high quality output and where speed is not an issue, e.g. digital camera applications
Dot matrix printer	Applications where noise is not an issue and copies have to be made, e.g. industrial environments (multipart forms, continuous stationery, labels etc.), car sales and repair companies, manufacturing sites Graph plotter CAD applications, particularly where large printouts are required such as A0
Speakers	Any application which requires sound to be output such as multimedia presentations and websites including encyclopaedias. Applications that require musical output such as playing of music CDs and DVD films

Control devices in Control applications

Motors	Automatic washing machines, automatic cookers, central heating controllers, computer-controlled greenhouses, microwave ovens, robotics, production line control
Buzzers	Automatic cookers, microwave ovens
Heaters	Automatic washing machines, automatic cookers, central heating controllers, computer-controlled greenhouses
Lights/lamps	Computer-controlled greenhouses

Examaple Question 4)

(a) Inkjet printers and laser printers are two common types of printer.
Describe the features and principles of operation of each type of printer.

(i) Inkjet printer

.....
.....
.....
.....
.....
.....
.....
..... [4]

(ii) Laser printer

.....
.....
.....
.....
.....
.....
.....
..... [4]

(b) Another type of printer is the 3D printer.
Describe 3D printing.

.....
.....
.....
.....
.....
..... [3]

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Examination Questions

Q1) Winter 2014 P13

A cinema (movie theatre) uses automatic machines to allow customers to select tickets for movie shows. Payments are made by credit or debit card.

(a) Identify **two** input devices which could be used by the cinema.

For **each** device, describe what it is used for.

input device 1 .....

use.....

.....

input device 2 .....

use.....

.....[4]

(b) Identify **two** output devices which could be used by the cinema.

For **each** device, describe what it is used for.

output device 1 ……

use.....

output device 2 .....

use.....

.....[4]

Q2) A microwave oven cooks food when the food is placed on a rotating plate and the door is closed.

The oven is controlled by a microprocessor.

(a) Name **two** sensors that could be used in the microwave oven.

1 .....

2 .....[2]

(b) Describe **two** items of data that the user would need to input before pressing the start button. Describe how these data could be input.

data1.....

.....

method of input 1

.....

.....

data2.....

.....

method of input 2

.....

..... [4]

(c) Describe the role of the microprocessor in the microwave oven.

.....

.....

.....

..... [4]

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Q3) Summer2014 P12

The following diagram shows six descriptions of automatic data capture methods and six terms.

Draw lines to connect each description to the correct term.

reading data directly from hard copy and converting into electronic/ computer-readable form	biometrics
use of fingerprint scans, retina scans, face identification, etc. as a way of identifying a person uniquely	data logging
recognises spoken word patterns and compares them to patterns stored in memory	optical character recognition (OCR)
use of minute electronic devices (containing microchip and antenna) that can be read from distances up to 5 metres	optical mark recognition (OMR)
automatic data collection using sensors	radio frequency identification (RFID)
system that reads pencil or pen marks on a piece of paper in pre-determined positions	voice recognition

[5]

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Q4) Winter 2013 P12

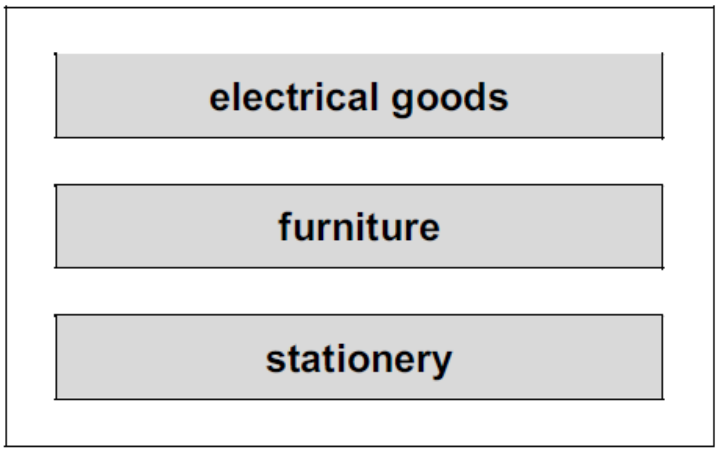
(a) Seven hardware items are shown on the right hand side in the diagram below. Three applications are shown on the left in the diagram.
By drawing arrows, link each application to the appropriate hardware items (each hardware item must be used once only):

	speakers
computer aided design (CAD)	light pen
	microphone
video conferencing	spaceball
	data goggles
virtual reality	webcam
	data gloves

[3]

(b) Name one additional item of hardware used in each of the three applications named in the above diagram.
CAD:.....
Video conferencing: .....
virtual reality : ..... [3]

Q5)A shop uses an information screen linked to a computer to allow customers to order goods directly. The first screen shows three options:



(a) What is the best input device to allow customers to choose one of the three options?
.....[1]

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Q6) Winter 2013 P13

A website has been set up allowing users to access the Periodic Table. Part of the table is shown below.

H																He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr

A user selects an element from the table and is then directed to another web page where details of the chosen element can be found.

(a) (i) What would be the most suitable input device for this application?

.....

.....[1]

(ii) Describe how your chosen input device would interact with the table.

.....

.....[1]

(b) Give two advantages of this system when compared to finding the same information from books.

.....

.....[2]

(c) Apart from security issues, give two disadvantages of this system compared to using books.

.....

..... [2]

Q7) Summer 2013. P12

Thin film technologies are becoming increasingly common. This uses material as thin as a sheet of paper but which acts just like an LCD monitor. A microprocessor is used to control the device and solid state memories are used to supply the data.

(a) Describe two advantages of thin film technology.

.....

..... [2]

(b) Describe two applications that could use thin film technology.

.....

..... [2]

Q8)A company requests new customers who register online to give the following details:

- name
- address
- type of credit/debit card
- payment card number

All details must be entered.

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(b) Other data required:
• date of birth
• male or female
• accept/decline company conditions
Describe suitable input methods for this data.
date of birth
male or female
accept/decline company conditions
.....
.....
..... [3]

Q9) Summer 2013. P11

Name a suitable hardware device to enable automatic data capture in each of the following applications. Each device must be different.

Application	Hardware device
automatic stock control system in a supermarket	
keeping track of the livestock on a large farm	
input data into a computer using speech recognition	

[3]

Q10) Winter 2012 P13

You have just been appointed as the IT representative of a small engineering company. The company needs to buy:

- external backing storage
- printers
- input devices

Choose a suitable example for each and give a reason for your choice.
1. .....
2. .....
3. .....[3]

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Q11) Winter 2012. P12

For each of the following five groups of hardware items, write down a computer application that would need those items.

List of hardware items	Application
webcam, microphone, speakers	
barcode reader, POS terminal	
pressure sensor, ADC, lights, siren	
data gloves, data goggles	
light pen, plotter, 3D printer	

[5]

Q12) Summer 2012. P12

A list of four printers and four different applications which use printers is shown below(a) Using arrows, link each printer to the most appropriate application.

Printing documents in a factory environment which is dusty and damp	3D printer
High quality printing of 30 000 colour booklets per day	Dot matrix printer
Producing prototypes in resin of a new design	Colour inkjet printer
Producing a colour poster	Colour laser printer

[4]

(b) Give one feature of each printer which makes it appropriate for the application.

3D printer.....

Dot matrix printer: .....

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Colour inkjet printer: .....
Colour laser printer: .....[4]

Q13) Winter 2011 P13

The following table shows three applications which require specialist output devices. For each application, suggest one possible output device and give a reason for your choice.

Application	Output device	Reason for choice of device
A visually impaired person using a word processor		
Using CAD to design a new engine		
Monitoring a house for burglars		

[6]

Q14) (b) (i) What is meant by automatic data capture?

.....
..... [1]

(ii) Name a device used in automatic data capture and describe an application thatusesit.

.....
.....

..... [2]

Q15) An airport has multimedia kiosks linked to a central computer.

(a) State two input devices, other than a keyboard, which might be used at the multimedia kiosks.

.....
..... [2]

(b) Give two items of information that might be accessed from multimedia kiosks.

.....
..... [2]

(c) State one advantage and one disadvantage for the airport of providing multimedia kiosks.

.....
..... [2]

Q 16) In a school, students can use laptop computers which link to the school's wireless network.

(a) State two advantages to students of using this system rather than desktop computers located in specialist computer laboratories.

.....
..... [2]

(b) Give two disadvantages of using laptop computers rather than using desktop computers.

.....
..... [2]

Q17) Winter 2010 P13

Complete the following table by writing down the most appropriate data collection method for the given application. [3]

Application	Data collection method
Reading information from a credit/debit card	
Choosing an option from a customer information screen at an airport	
Reading the results from a questionnaire where pencil lines were used to choose options	

Q18)Summer 2010 P11

(a) Give three different types of device that allow human beings to interface with computer systems.

.....
..... [3]

(b) Give three automatic data capture devices and give a suitable application for each device

.....

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.....
.....
.....
.....
..... [6]

Q19) Describe how a supermarket would use computer technology to carry out automatic stock control.

.....
.....
.....
..... [3]

Q20) Summer2010 P12

A supermarket makes use of barcodes on all its goods as part of its automatic stock control system.

(a) Describe how the price is found for each item sold.

.....
..... [2]

(b) The following are steps in the automatic stock control system.
Number the steps in the correct order.

if stock level ≤ minimum stock level	
report printed out for the manager	
stock level reduced by 1	
new stock value written back to file	
more items are ordered automatically	

[4]

Q21)A factory uses a computer system to store information about customers, spare parts and general administration.

(a) Spare parts can be identified by selecting from diagrams on a computer screen. Describe what hardware would be needed to allow the parts to be selected in this way

.....
..... [2]

(b) The factory needs to buy a new printer. It has decided to buy either a dot matrix printer or an inkjet printer. Discuss the advantages and disadvantages of using both types of printer in this application.

.....
.....
.....

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..... [3]

Q22) Winter 2009 P1

Explain, with examples where appropriate, the following five computer terms.

ROM

.....

..... [1]

(a) How could a computer simulation be used by a supermarket to reduce queuing at checkouts?

.....

..... [2]

(b) The supermarket has decided to fit sensors at the shop entrance to count people coming in and leaving.

i) What type of sensor would be suitable to detect people?

.....

..... [1]

(ii) How could the supermarket use the information obtained from these sensors?

.....

..... [2]

(c) The supermarket has decided to fit information screens at various locations for customer use. These information screens do not use keyboards.

(i) Give one example of a suitable input device.

..... [1]

(ii) What information could be made available to supermarket customers?

.....

..... [1]

(iii) Give one advantage of using this system rather than displaying signs and notices around the supermarket.

.....

..... [1]

Q23) Summer 2009

Explain, using examples where appropriate, the meaning of these computer terms.

(a) batch processing

.....

..... [2]

(b) data logging

.....

..... [2]

Name three devices used for automatic data capture.

.....

..... [3]

Q24) Summer 2008

Explain, using examples where appropriate, the meaning of these computer terms.

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(d) laptop computer

.....
..... [2]

(e) tracker ball

.....
..... [2]

Name two types of automatic data capture and give one application for each type named.

.....
.....
.....
..... [4]

Q26) Winter2008 P1

A supermarket uses a computer system to control and order stock. All products sold are identified with a bar code which can be read at a Point Of Sale (POS) terminal.

(a) Apart from stock control, give one advantage to the supermarket of having bar codes on the products.

..... [1]

(b) Give one advantage to the customer of using POS technology.

.....
..... [1]

(c) Describe how a computerised stock control system works.

.....
..... [3]

Explain, using examples where appropriate, the meaning of these computer terms.

(a)mouse

.....
..... [2]

(d) RAM

.....
..... [2]

Q27) Winter 2007 P1

A company checks its electrical equipment every three years. To help make sure that every item is checked at the correct time, the company has decided to put barcodes on the equipment. The barcode contains:

• type of equipment (e.g. monitor)
• location (e.g. Room 507)

Every time equipment is checked, the barcode is scanned and the data stored on a file.

(a) Give one other piece of information that should be on the barcodes.

..... [1]

(b) Give one example of other information that should be stored on the file itself.

..... [1]

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(c) Give two advantages of this system rather than using sticky labels on the equipment marked, for example, “Do not use after May 2007”.

.....
..... [2]

(d) Describe another application where barcodes could be used.

.....[1]

Q28) Summer 2007 P1

Describe the difference between speech recognition and speech synthesis.

.....
..... [2]

Describe three ways you could modify a typical input/output environment to enable people with disabilities to use the computer system.

.....
..... [2]

Items sold in supermarkets are all marked with bar codes.

(a) Customers are given an itemised bill at the checkout. Give two advantages to the customer.

.....
..... [2]

(b) Give two ways the information on the bar code can be input at the checkout.

.....
..... [2]

(c) Describe how bar codes are used in automatic stock control.

.....
..... [2]

Q29) Summer2006 P1

Name two devices used for direct data capture. Give one application for each device named.

Device 1: .....

Use ..... [2]

Device 2: .....

Use ..... [2]

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Marking Scheme

Example Questions:

Q2) • barcode reader/scanner, • Keypad / numpad / number pad
• Touchscreen / touchpad, • Mouse

Q3) (a) laser printer features
• high speed printing
• suitable for large volume printing
• high quality printing
drawbacks
• expensive to buy toner/diffuser
• produce ozone/toner particulates in the air
inkjet printer features
• high quality colour printing
drawbacks
• large print runs require frequent changing of cartridges
• ink needs time to dry or it smudges
• heads can clog up with ink if left standing
• expensive running costs / high cost of ink
• too slow for large print runs [2]
(ii) 3D printer features
• builds up a solid object by "printing" thin layers (tomography technique)
• creates prototypes
• solid objects actually work which is ideal for CAD work
• many types now exist that use resin, powdered metal, paper, plastics, etc.
drawbacks
• expensive to buy
• very slow to produce output
• raw materials / consumables expensive to buy
• can only produce items of a small size
(graph) plotter features
• ability to produce very large drawings/blueprints
• they use "pens" to draw lines / accurate shapes
drawbacks
• expensive to purchase / maintain
• very large footprint
• slow plotting process [2]

Q4) (a) (i) Inkjet printer
Any four from:
– uses cartridges/liquid ink
– makes use of thermal bubble/piezoelectric technology
– sprays ink in droplets on the paper
– uses a moving print head
– suitable for low volume (high quality) output, e.g. a photo [4]
(ii) Laser printer
Any four from:
– uses powdered ink/toner cartridges
– uses a (charged) printing drum
– makes use of static electricity charges
– uses a fuser to fix/melt ink onto the paper
– uses a discharge lamp to remove static charge from the drum
– useful for high volume (high quality) output, e.g. leaflets [4]
(b) Any three from:
– produces solid, 3D objects/prototypes
– used in CAD/CAM
– makes use of tomography/slices of an object
– solid built up in thin layers
– uses resin, powdered metal, paper, plastic… [3]

Examination Questions:

Q1)
(a) 1 mark for input device + 1 mark for its matching use
input device: touch screen
use: select film / cinema seats / price
input device: keyboard / keypad
use: input number of tickets / card PIN
input device: magnetic stripe reader / chip and PIN reader / card

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reader
use: reading credit / debit card details
input device: scanner
use: to read any promotional vouchers (etc.) [4]
(b) 1 mark for each different output device + 1 mark for its matching use
output device: screen / monitor
use: show films available / seating plan / prices of each seat / payment details
output device: printer
use: print receipt / tickets
output device: loudspeaker / beeper
use: to indicate error in input / confirmation of keys pressed [4]
Q2) (a) 1 mark for each different sensor (max 2)
– pressure sensor
– example of sensor to detect if door closed / open e.g. magnetic field sensor, proximity sensor
– moisture / humidity sensor
– temperature / infrared sensor[2]
(b) 1 mark for each item of data (max 2):
– is the food frozen / uncooked / cooked?
– cooking time
– start / end time
– power
– weight
– type of food
– additional cooking feature e.g. browning
1 mark for each corresponding input method (max 2):
– turn dial to select option
– touch screen / buttons / concept keyboard / keypad to select options
– use of barcode readers (to read barcodes on food packaging which stores an automatic
cooking programme)[4]
(c) Any four from:
– (microprocessor) checks / receives readings / data / signals from sensors….
– …..continuously
– if door open, (microprocessor) sends signal to sound alarm / stop process
– (microprocessor) compares weight of food against stored values…
– …and automatically sets cooking time / power
– cooking time controlled by (microprocessor) comparing with stored values
– (microprocessor) sends signal to beeper / notify when cooking program complete [4]
Q15) (a) Any two input devices from:
touch screens/light pens
roller/tracker ball/mouse/joystick
microphone
touch pads (containing options shown on keys)
[2]
(b) Any two examples from:
maps/directions
prices of goods/shop products
flight details
bank statements/bills
travel offers
news updates
emails/messages [2]
(c) Any one advantage from:
airport can advertise services/products
24/7 service

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airport can get revenue from other advertisers
airport can give security information/warnings
less staff needed for information desks
quicker response to customer enquiries
Any one disadvantage from:
(cost of) maintenance
central computer might crash/over-reliance
hacking
viruses [2]

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1.3.5 Memory, storage devices and media

1.3.5 Memory, storage devices and media
• show understanding of the difference between: primary, secondary and off-line storage andprovide examples of each, such as, primary: Read Only Memory (ROM), Random Access Memory(RAM) and DVD-RAM; secondary: hard disk drive (HDD) and Solid State Drives (SSDs); off-line:Digital Versatile Disks (DVDs), Compact Disks (CDs), Blu-ray, USB flash memory and removabledisks
• describe the principles of operation of a range of types of storage devices and media includingmagnetic, optical and solid state
• describe how these principles are applied to currently available storage solutions, such as SSDs,hard disk drives, USB flash memory, DVDs, CDs and Blu-ray
• calculate the storage requirement of a file

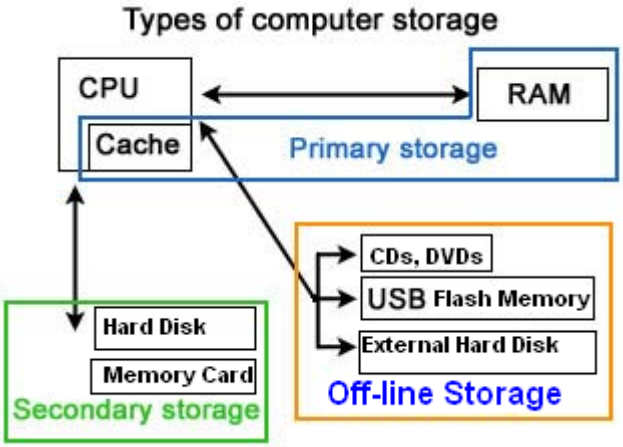
Storage Media & Devices

The device that actually holds the data is known as the **storage medium** ('media' is the plural).

The device that saves data onto the storage medium, or reads data from it, is known as the **storage device**.

Storage Device: The machine which stores data on storage medium.

Storage Media: The physical material in which a devices stores data.



A computer holds programs and data in three sorts of device:

1. Primary — limited-capacity and rapid-access during processing
2. Secondary — larger-capacity and slower-access to keep data/programs for future use. They remain inside computer.
3. Off-line — portable, they are removed after read/write data.

Primary memory

Primary memory consists of:

- Non-volatile, read-only memory (ROM) to hold a small program to start up computer, BIOS, firmware, permanent
- volatile, read-write, random access memory (RAM) to hold the programs and data currently being processed, user memory, temporary

ROM is Read-Only Memory.

The ROM contains the program that is used to start up the computer. This is also called the boot program because the process of starting up the computer is also called 'booting up' the computer. In many desktop computer systems, the boot program is also called the BIOS or Basic Input Output System.

ROM is not volatile and is the same even when the computer is turned off. Also, the program inside the ROM is not easily deleted or changed. This means the boot program will always be there when the computer is started. This is why any computer system needs some ROM.

On a standard personal computer, the boot program does the following things:

- It performs some basic checks.
- It finds the operating system and loads it into the RAM.
- It then hands control over to the operating system.

RAM is Random Access Memory.

RAM is used to store the programs and data that the computer is currently working on. It is the working memory of the computer. The operating system needs to be in the RAM so that it can run. If you want to run a program or listen to a piece of music, it will need to be loaded into the RAM first. If you type into a text file, the text file will also be in the RAM. Any changes you make to the file will be made in the RAM until you save the file. RAM is volatile. This means that when the power is turned off, everything that is stored in the RAM is lost.

The more RAM a computer has, this means that it can deal with larger programs, larger data files and can run more programs and data files at the same time. More usually, this also means that the computer can multi-task more. This means the computer is dealing with several programs and files at the same time.

Measuring the size of memory

4 bits = 1 nibble, 8 bits=1 byte,
2^{10} Bytes = 1024 bytes= 1 Kilo Byte
2^{20} Bytes = 1024 KB= 1 Mega Byte,
2^{30} Bytes = 1024 MB= 1 Giga Byte,
2^{40} Bytes = 1024 GB= Tera Byte
2^{50} Bytes = 1024 TB= 1 Peta Byte

Types of RAM:

DRAM

Dynamic random-access memory (*DRAM*) is a type of storage that is widely used as the main memory for a *computer* system. Dynamic random-access memory (DRAM) is a type of random-access memory that stores each bit of data in a separate capacitor within an integrated circuit. The capacitor can be either charged or discharged; these two states are taken to represent the two values of a bit, conventionally called 0 and 1. A DRAM storage cell is dynamic in that it needs to be refreshed or given a new electronic charge every few milliseconds to compensate for charge leaks from the capacitor.

SRAM

SRAM (static RAM) is random access memory (RAM) that retains data bits in its memory as long as power is being supplied. Unlike dynamic RAM (DRAM), which stores bits in cells consisting of a capacitor and a transistor, SRAM does not have to be periodically refreshed.

Differences between SRAM & DRAM

SRAM	DRAM
does not need to be refreshed as the transistors hold the data as long as the power supply is on	requires data to be refreshed periodically in order to retain the data
requires less power consumption	requires higher power consumption which is significant when used in battery-powered devices
has more complex circuitry	Has simpler circuitry
used predominantly in cache memory of processors where speed is important	

Differences between RAM and ROM

	RAM	ROM
What does it contain?	Operating system, programs and data which are currently being used.	A program used to start the computer called the 'boot program' or BIOS.
Can the contents be changed? (Is it volatile?)	Yes. The contents of the RAM are changed all the time while the computer is running.	No. The contents of ROM cannot normally be changed.
How big is it?	Typically 3-4Gb. The larger the better because this means that the computer can run more programs at the same time.	Typically 1 -2Mb. Small because it only needs to store the boot program.

Secondary Storage

Secondary storage has to be non-volatile and includes:

- hard disks
- solid-state storage memory cards

Hard Drives

Hard-drives have a **very large storage capacity** (up to 1TB). They can be used to store vast amounts of data. Hard-drives are **random access** devices and can be used to store all types of films, including **huge files** such as movies. Data **access speeds** are **very fast**.

Data is stored inside a hard-drive on rotating metal or glass discs (called 'platters'). Hard disk stores information in the form of magnetic fields. Data is stored digitally in the form of tiny magnetized regions on the platter where each region represents a bit. To write a data on the hard disk, a magnetic field is placed on the tiny field in one of these two polarities: N-S – If North Pole arrives before the south pole and S-N – if the south pole arrives before the north pole while the field is accessed. An orientation in the one direction (like N-S) can represent the '1' while the opposite orientation (S-N) represents "0". This polarity is sensed by integrated controllers built within the hard disk.

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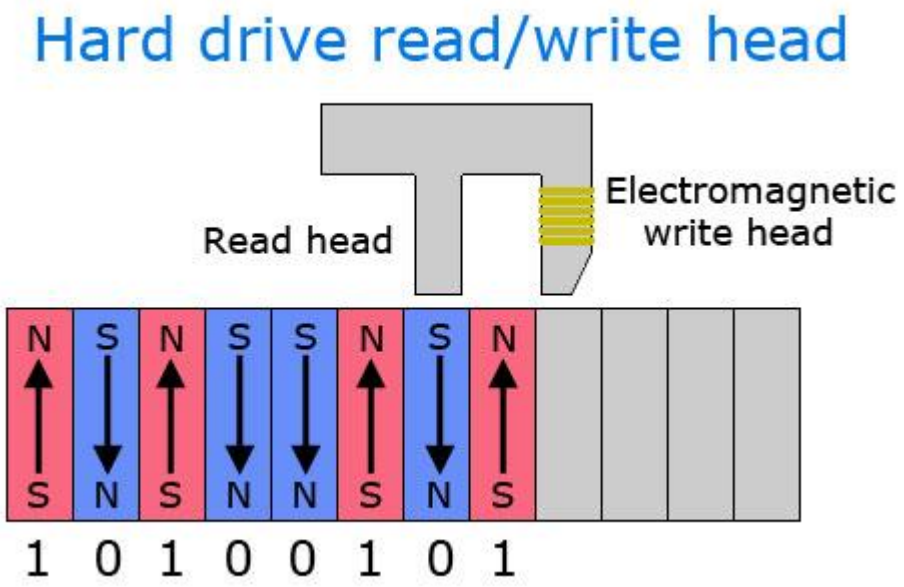

Memory Cards

Many of our digital devices (**cameras**, **mobile phones**, **MP3 players**, etc.) require **compact**, **non-volatile** data storage. Flash memory cards provide this and come in a variety of shapes and sizes.

One of the most common formats used by digital cameras is the SD Card. The cards store the digital images taken by the camera.
Mobile phones contain a Subscriber Identity Module (**SIM**) card that contains the phone's number, the phonebook numbers, text messages, etc.

Many phones also have extra memory cards to store music, video, photos, etc. (e.g. Tiny Micro-SD cards).

'Solid-State'?

The term 'solid-state' essentially means 'no moving parts'.
Solid-state storage devices are based on **electronic circuits** with **no moving parts** (no reels of tape, no spinning discs, no laser beams, etc.)
Solid-state storage devices store data using a special type of **memory** called **flash memory**...

Off-line Storage

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Offline storage refers to any storage medium that must be physically inserted into a system every time a users wants to access or edit data. Offline storage can be any type of internal or external storage that can easily be removed from the computer.
Offline storage is also known as removable storage and include:

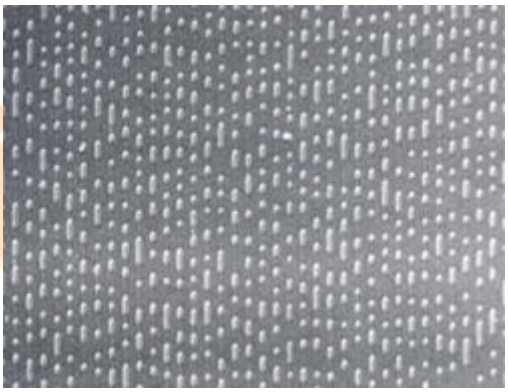
- Optical devices like CDs, DVDs
- Solid state USB memory sticks
- External Hard disk

Optical Storage Devices / Media

Why 'Optical'?

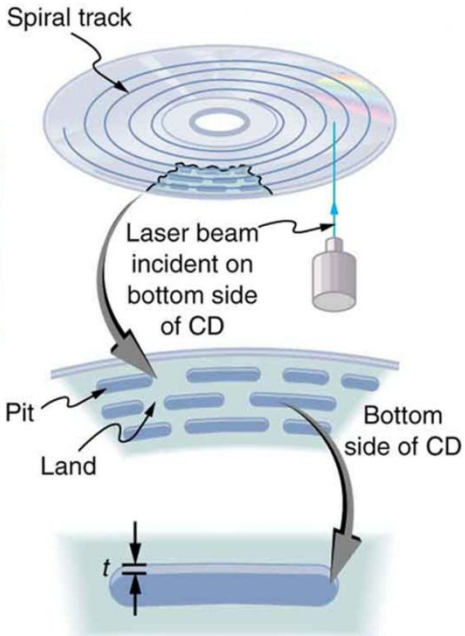
Optical storage devices save data as patterns of **dots** that can be read using **light**. A **laser beam** is the usual light source.

The data on the storage medium is read by bouncing the laser beam off the surface of the medium. If the beam hits a dot it is **reflected** back differently to how it would be if there was no dot. This difference can be detected, so the data can be read.



Dots can be created using the laser beam (for media that is **writable** such as CD-Rs). The beam is used in a high-power mode to actually mark the surface of the medium, making a dot. This process is known as '**burning**' data onto a disc.

This is a magnified view of the dots on the surface of a CD.
The different patterns of dots correspond to the data stored on the disc.



A CD has digital information stored in the form of laser-created pits on its surface. These in turn can be read by detecting the laser light scattered from the pit. Large information

Stores data as tiny pits pressed into flat surface by laser.

– Optical discs such as CDs and DVDs have smaller capacities than HDDs or tapes and are also more expensive per gigabyte of storage. They are also direct access media, with rather slower access than a HDD, and are removable and highly portable. The main types of CD and DVD have different suffixes, as follows:
– **ROM** stands for 'Read-Only Memory' – these cannot be written to, and are suitable for the distribution of music, movies, software and encyclopaedias
– **R** stands for 'Recordable' – these can be written to just once and then can only be read from, making them suitable for storing music or movies or archive copies of documents

– **RW** stands for 'ReWritable' – these can be written to and read multiple times, making them suitable for making temporary copies of data files for transfer from one computer to another or regular backup copies

DVD-RAM is a DVD (optical disc) technology for high-capacity data storage for computers. Like ordinary random access memory (RAM), it can be repeatedly read, written to, and erased. Intended mostly for removable computer storage, DVD-RAM provides the capabilities of Rewriteable CD (CD-RW) - users can run programs from the discs, copy files to them and rewrite or delete them. However, with a storage capacity of up to 9.4 gigabytes (GB) per double-sided disc, DVD-RAM has many times the capacity of CD-RW.

– **Blu-ray discs (BD or BR)** have larger storage capacities than other optical storage media and a higher rate of data transfer. Although disks are expensive, their cost per gigabyte of storage is nearer to that of a HDD

Flash Memory

Flash memory is a type of Electronically-Erasable Programmable Read-Only Memory (**EEPROM**). Flash memory is **non-volatile** (like ROM) but the data stored in it can also be **erased** or **changed** (like RAM).

Flash memory can be found in many data storage devices...

You might wonder why, since flash memory is non-volatile, normal computers don't use it instead of RAM. If they did we would have computers that you could turn off, turn back on again and no data would be lost – it would be great!

*The reason is **speed** – saving data to flash memory is very slow compared to saving it to RAM. If a computer were to use flash memory as a replacement for RAM it would run very **slowly**. However some portable computers are starting to use flash memory (in the form of **solid-state 'discs'** as a replacement for **hard-drives**. No moving parts mean less to go wrong and longer battery life.*

USB Memory Sticks

Memory sticks (or 'thumb-drives') have made many other forms of portable storage almost obsolete (why burn a CD or DVD when you can more easily copy your files onto a memory stick?).

Memory sticks are **non-volatile**, **random-access** storage devices.

Each of these small devices has some **flash memory** connected to a **USB interface**. Plug it into your computer and it appears as a drive. You can then add files, erase files, etc. You can use it to **move any type of file** between computers.

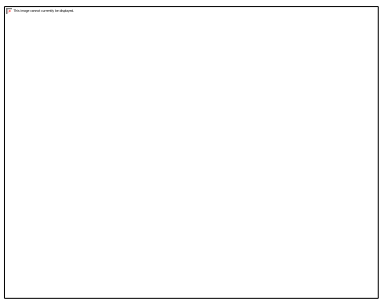
Flash memory used to be very expensive, but in recent years it has become much **cheaper** and you can now buy a 16GB memory stick for just a few dollars.

Portable Hard Drive

A portable hard-drive is one that is placed into a **small case** along with some electronics that allow the hard-drive to be accessed using a **USB** or similar connection.

Portable hard-drives allow very **large amounts of data** to be **transported** from computer to computer.

Many portable music players (such as the iPod classic) contain tiny hard-drives. These miniature devices are just not much bigger than a stamp, but can still store over 100MB of data!

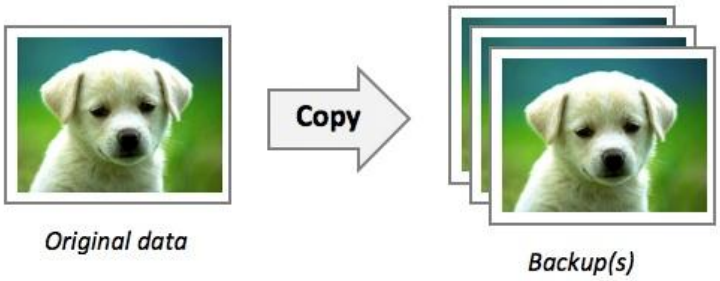


Backing up Data

What is a Backup?

A backup simply means making **one or more copies** of your data.

For example, if you have a folder of photos stored on the hard-drive of your laptop, you might back them up by copying them to a CD-R.

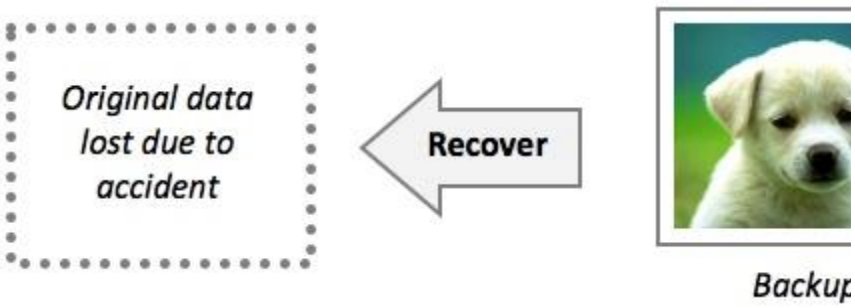


*Note: If you move the photos from the hard-drive to a CD-R, you do **not** have a back-up – you still only have **one copy** of the photos, but now they are on a CD instead of the hard-drive.*

*You only have a backup if you have a **second copy** of your data.*

Why Backup Your Data?

If you delete a file by accident, your computer breaks, your laptop is stolen, or your business burns to the ground, having a backup copy means that you have not lost your precious data. You can recover your lost files and continue working.



Most businesses use computers to store very important data (customer records, financial information, designs for

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products, etc.) If this data is lost, the business could possibly have to close. Backing-up business data is essential.

How Are Backups Created?

Personal backups of the data on your hard-drive can be made by…

- Burning files to a **CD-R**
- Copying files to an **external hard-drive**
- Copying the files to **another computer** on a network

Businesses backup essential data by…

- Making copies of data **very regularly**
- Using large-capacity media such as **magnetic tape**
- Keeping **old copies** of backups, just in case
- **Automating** the system so that nobody forgets to do it!
- Keeping backup media **off-site** (in case of fire or theft)

Summary

Media	Use
Magnetic backing storage media	
Fixed hard discs	Used to store operating systems, software and working data. Any application which requires very fast access to data for both reading and writing to. Not for applications which need portability. Used for online and real time processes requiring direct access. Used in file servers for computer networks
Portable hard discs	Used to store very large files which need transporting from one computer to another and price is not an issue. More expensive than other forms of removable media
Magnetic tapes	Any application which requires extremely large storage capacity and speed of access is not an issue. Uses serial access for reading and writing. Used for backups of file servers for computer networks. Used in a variety of batch processing applications such as reading of bank cheques, payroll processing and general stock control
Optical backing storage media such as CDs and DVDs	CDs tend to be used for large files (but smaller than 1Gb) which are too big for a floppy disc to hold such as music and general animation. DVDs are used to hold very large files (several Gb) such as films. Both CDs and DVDs are portable i.e. they can be transported from one computer to another. Both can be used to store computer data
CD ROM/DVD ROM	Applications which require the prevention of deletion of data, accidental or otherwise. CDs used by software companies for distributing software programs and data; by music companies for distributing music albums and by book publishers for distributing encyclopaedias, reference books etc. DVDs used by film distributors
CD R/DVD R	Applications which require a single 'burning' of data, e.g. CDs –recording of music downloads from the internet, recording of music from MP3 format, recording of data for archiving or backup purposes. DVDs – recording of films and television programs
CD RW/DVD RW	Applications which require the updating of information and ability to record over old data. Not suitable for music recording but is very useful for keeping generations of files. DVDs have between five and ten times the capacity of CDs
DVD RAM	Same properties as DVD RW but quicker access and data can be overwritten more easily. Similar to floppies in nature but has 3000–6000 times more storage

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	and uses optical technology
Blu-ray	Capacities of 25Gb, 50Gb and 100 Gb. Used for storing films (movies). 25Gb equates to 2 hrs HDTV, 13hrs standard definition TV. It is possible to playback video on a disc while simultaneously recording HD video. (Will be) used for storage of PC data
Solid state backing storage	Smallest form of memory used as removable storage. More robust than other forms of storage. More expensive than other forms, but can be easily written to and updated
Memory sticks/Pen drives	Can store up to many Gb. Used to transport files and backup data from computer to computer
Flash memory cards	Used in digital cameras, palmtops, mobile phones, MP3 players

PATEL

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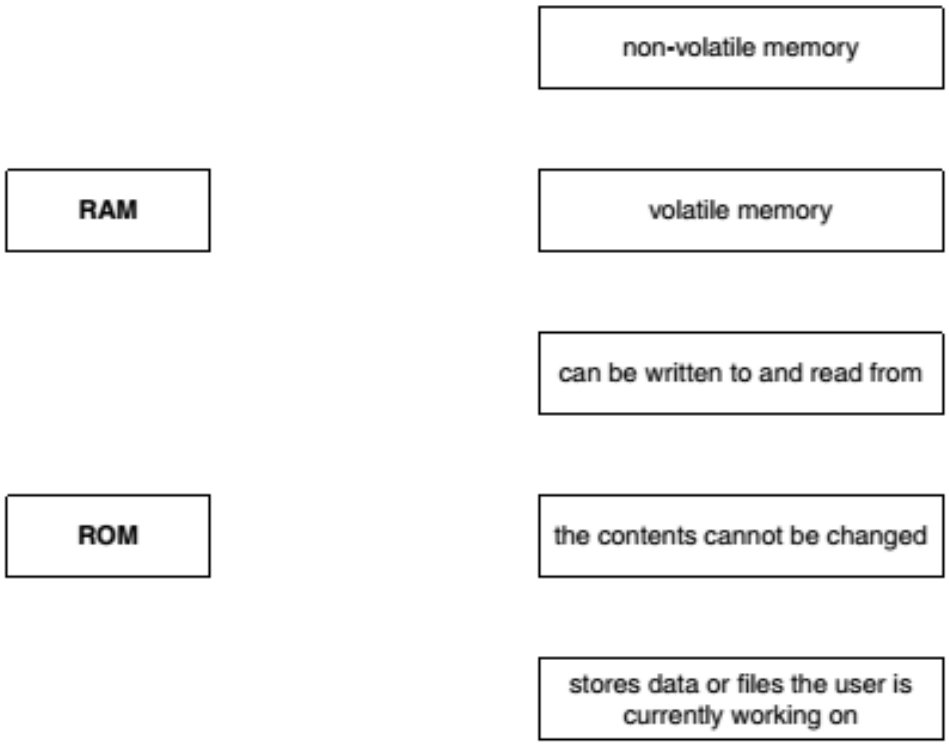
Examination Questions

Q1) Winter 2014 P3

In the diagram below, there are **two** types of memory shown on the left and **five** typical memory features shown on the right.

Link each feature to **either** RAM **or** ROM by drawing connecting lines.



[5]

Q2) Specimen 2015 P1

Kamil is setting up a new computer system to record television programmes. He wants to be able to record, view and then erase programmes that he does not want to keep. He has chosen to use DVD-RAM as an optical storage medium.

Explain to Kamil why it is better to use DVD-RAM rather than DVD+RW or DVD-RW.

1 .....

2 ..... [2]

Q3) Specimen 2015 P1

Computer memories are measured in terms of the number of bytes.

(a) (i) What is meant by the term byte?

.....

..... [1]

(ii) What is meant by the term Gigabyte?

.....

..... [1]

(b) Flash memories and CD-RWs are used as backing media for computers.

Give two differences between these two media.

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1 .....
2 ..... [2]

Q4) Summer 2013 P13 (Question 1)

Name a suitable sensor for each of the following applications.
Choose a different sensor in each application.
(i) control of a central heating system
(ii) operation of automatic doors
(iii) detection of intruders
(iv) monitoring of a greenhouse environment

1 .....
2 .....
3 .....
4 ..... [4]

Q5) Summer 2013 P13 (Question 1)

You have just been appointed as the IT representative of a small engineering company.
The company need to buy:

- external backing storage
- printers
- input devices

Choose a suitable example for each and give a reason for your choice.
External storage device: .....
Reason for choice: .....
Printer type: .....
Reason for choice: .....
Input device: .....
Reason for choice: ..... [6]

Q6) Summer 2013 P12 (Question 2)

Four types of data storage media and four descriptions are shown in the table below.
Tick (_) the appropriate boxes in the table to match each data storage medium to its most suitable description.

Q7) Summer 2013 P12 (Question 3)

Three common devices are listed below:

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• MP3 player
• digital camera
• mobile phone
(a) Choose one of the above devices.
Describe the type of internal memory the device uses.
Describe how data is transferred from the device to a computer.
Device: ……..
Type of internal memory used: ……
Method of transferring data to a computer: …… [3]

(b) Modern mobile phones include a digital camera and an MP3 player.
(i) Give one disadvantage when compared to a dedicated MP3 player.
……
……

(ii) Give one disadvantage when compared to a dedicated digital camera. [2]
……
……

Q8) Winter 2012 P12 (Question 3)
For each of the following five groups of hardware items, write down a computer application that would need those items.

List of hardware items	Application
webcam, microphone, speakers	
barcode reader, POS terminal	
pressure sensor, ADC, lights, siren	
data gloves, data goggles	
light pen, plotter, 3D printer	

Q9) 9691_13W_P13
(a) Define the terms hardware and software.
hardware: ……
software: …… [2]
(b) A cinema allows its customers to buy tickets from an automatic dispensing machine. Payment can be made either with cash, or by debit or credit card.
State two input and two output devices that would be needed and give reasons for your choice of device.
Input device 1: ……
Reason: ……
Input device 2: ……
Reason: ……
Output device 1: ……
Reason: ……

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Output device 2: ……
Reason: …… [8]

Q12) 9691_13W_P11

(a) Describe the main differences between RAM and ROM.

……
……
…… [3]

(b) Data logging devices contain both RAM and ROM.
Describe the role of each type of memory in these devices.

RAM: ……
ROM: …… [2]

Q13) 9691_s13_p11

(a) State three different types of secondary storage media.
Explain how digital data is stored on each.

Type 1: ……
Type 2: ……
Type 3: …… [6]

(b) A remote-controlled toy car contains both RAM and ROM. The car can be programmed to carry out a number of manoeuvres.

(i) Describe the main differences between RAM and ROM.

……
…… [2]

(ii) How are the two types of memory used in the car?

……
…… [2]

Q14 (a) Describe the main differences between Random Access Memory (RAM) and Read Only Memory (ROM).

(b) Various external, removable memory devices exist. Choose which device (using a **different one** in each case) you would use for the following, and give a reason for your choice:

(i) Storing multimedia files
(ii) Storing music files
(iii) Storing documents produced on a word processor

Application	Device	Reason for choice
Multimedia files	MP4 or DVD	Holds large amounts of data to allow audio, visual, video and animation
Music files	MP3	Compresses sound files to allow several tracks to be stored using less memory
Word processed document	CD or flash memory	Can store files which can be taken away and used on any computer; don't normally need a huge memory capacity therefore other devices not really needed

Q15) (a) A music file is 45 Mbyte in length. Approximately how much memory space would this same file need if stored in MP3 format?

……
……
……

(b) Describe how it is possible to store considerably more data on a DVD than on a CD even though dimensionally they are the same?

……
……
……

(c) Why have CDs and DVDs taken over from floppy disks as the main secondary storage media on home computer systems?

……
……

Q16) (a) Mobile phones are communication devices. They allow communication via speech or text messaging.

(i) Most mobile phones offer predictive texting.

State what is meant by this term.

……
…… [1]

(ii) What two additional functions would you expect to find on a mobile phone?

1: ……

2: …… [2]

(b) Connecting a USB telephone to a computer allows communication using VoIP technology.

(i) Give one advantage of using VoIP rather than other telephone systems.

……

(ii) Give one disadvantage of using VoIP rather than other telephone systems.

……

(iii) To use VoIP, there is no need to use a USB telephone.

What other hardware could be used to allow verbal communications?

…… [3]

Q16) A company advertises its Internet broadband speeds as follows:

• download speed of 128 megabits per second

• upload speed of 16 megabits per second (8 bits = 1 byte)

(a) Explain what is meant by the two terms download speed and upload speed.

Download speed: ……

Upload speed: …… [2]

(b) Give two advantages of using broadband rather than dial-up.

1: ……

2: ……[2]

(c) Give two different scenarios when a fast broadband connection is essential.
1: ……
2: ……[2]
(d) How many 4-megabyte files could be downloaded per second using this company's broadband? [1]

Q17) Specimen Paper 1 for 2011
State two desirable properties of processors found in laptop computers. Explain why the selected property is desirable. ()
……
……
……

Q18) Winter 2008
(b) Describe two special devices that are used for man–machine interaction in virtual reality systems.
(c) Give two examples of typical output from a virtual reality system. ()
……
……

Q19) Winter 2009
The digital CCTV camera is connected to a computer. The computer can make the camera move in any direction by sending out digital signals. The computer system has a 400 gigabyte hard disk.
(e) Each image size is 400 kilobytes (0.4 gigabytes).
(i) How many images can be stored before the hard disk is full?
……
……
(ii) Once the hard disk is full, how can the system ensure that the stored images are not lost and new images can be stored?
……
……

Q20) Winter 2009
(b) The supermarket has decided to fit sensors at the shop entrance to count people coming in and leaving.
(i) What type of sensor would be suitable to detect people?
……
……
(ii) How could the supermarket use the information obtained from these sensors?
(i) infra-red sensor: …… [1]

Q21) Summer 2012 Question Paper 11
Video conferencing, Voice over Internet Protocol (VoIP) and instant messaging are all used as communication methods. Certain devices are essential to enable each of these communication methods to be used.
Tick () the appropriate cells in the table below to show which one or more devices are

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essential for each method. [3]

	keyboard	microphone	Speaker	webcam
VoIP				
video conferencing				
instant messaging				

Describe ways to guard against each of the following Internet security issues. (A different method should be given in each case.)
Viruses: ……
Hacking: ……
Spyware: ……
Phishing: ……
Tapping into wireless networks ……[5]

Q22) Jatinder uses Internet banking.
(a) Give one benefit and one drawback of using Internet banking.
Benefit: ……
Drawback: …… [2]
She uses a 5-digit PIN.
(b) Every time she logs on, she is asked to give 3 random digits from the PIN. She was asked to give her 3rd, 1st and 4th digit. This changes every time she logs on.
Give a reason for this.
……
……[1]

Q23) Summer 2012 (Question Paper 12)
Both email and mobile phones can be used to send messages.
Give one advantage and one disadvantage of using each method when compared to each other.
(i) Email:
Advantage: ……
Disadvantage: ……
(ii) Mobile phones:
Advantage: ……
Disadvantage: …… [4]

Q24)A computer system is to have wireless access (Wi-Fi) to the Internet.
State five potential security issues.
1: ……
2: ……

3: ……
4: ……
5: …… [5]

Q25) Winter2007

1 Explain, with examples, the following five computer terms:

(a) Byte [2]

(b) CD-ROM [2]

Q 26) Summer 2008

A computer system comes equipped with DVD writer/reader, hard disk drive and RAM.

(a) Give a different use for each of these forms of memory.

DVD

Hard Disk

RAM

(b) Give another example of a memory device and give one advantage of the named device.

Q27) Summer 2009

A company produces animation effects using computers rather than producing them manually.

(b) Each image takes about 400 kilobytes of storage. 25 images per second are produced.

How much memory would be needed to store a 30-minute animation?

……
……
……

Q28) Winter 2010 P11 (7010)

Explain, using examples where appropriate, the following five computer terms:

- USB flash memory
- RAM

Q29) Winter 2010 P13(7010)

Explain, with examples where appropriate, the following five computer terms.

(b) Optical media

A typical computer system contains the following four components:

_ RAM
_ ROM
_ hard disk
_ modem

Describe the function of each of these components.

……
……

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……**[4]**

Q30) Summer 2011 P12 (7010)
Name THREE different types of storage media and give an example of each.
1: ……
2: ……
3: ……

Q31) Summer 2012 P12 (7010)
The electronic equipment contains RAM and ROM. Give one use of each type of memory. **[2]**

Q32- 7010 S12 qp12) John has bought a 4 Gbyte MP3 player.
(You may assume: 1 byte = 8 bits, 1 Mbyte = 1024 Kbytes and 1Gbyte = 1024 Mbytes)
(i) We can assume that each song lasts 3 minutes and is recorded at 128 kbps (kilobits per second).
How much memory is required per song? [2]
(ii) Using your answer in (i), how many songs can be stored on John's MP3 player? [2]
(b) John also bought a device for recording television programmes. It allows him to record a programme at the same time as he is watching an earlier recording.
Describe how such a system would work.

Q33) Winter 2012 P12
The following statistics refer to a music track being recorded on a CD:
• music is sampled at 44 100 times per second
• each sample is 16 bits
• each track requires separate sampling for left and right speakers of a stereo recording
(8 bits = 1 byte, 1 megabyte = 1 048 576 bytes)
(a) (i) How many bytes are required to represent one second of sampled music?
[2]
(ii) If a typical music track is 3 minutes long, how much memory is used on the CD to store one track? (Give your answer in megabytes.)

Q35) Summer 2013 P12
The speed at which a CD spins in a portable music CD player is controlled by sensors and a small microprocessor.
(a) Describe how the sensors and microprocessor are used to control the speed of these pinning CD. [4]
(b) Sudden movements can make the CD "skip".
How can the microprocessor deal with this so that the CD operates correctly? [2]
(c) Why would an MP3 player not suffer from the same problem? [1]

Memory Size Calculation:

Q36) A company produces animation effects using computers rather than producing them manually.

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(b) Each image takes about 400 kilobytes of storage. 25 images per second are produced.

How much memory would be needed to store a 30-minute animation?

Q37) Juan uses a company which offers the following
Internet broadband transfer rates:
• 56 megabits per second DOWNLOAD
• 16 megabits per second UPLOAD

(b) If each music track is 3.5 megabytes in size, how long would it take Juan to download his 40 tracks?(Show your working.)

(c) He has decided to upload 36 photographs onto his social networking website. Each photograph is 1.8 megabytes in size.
How long would it take to upload his photographs?

Q38) . John has bought a 4 Gbyte MP3 player.
(You may assume: 1 byte = 8 bits, 1 Mbyte = 1024 Kbytes and 1Gbyte = 1024 Mbytes)
(i) We can assume that each song lasts 3 minutes and is recorded at 128 kbps (kilobits per second).
How much memory is required per song?

Q39) A digital security camera was set up as shown in the diagram.
The digital CCTV camera is connected to a computer. The computer can make the camera move in any direction by sending out digital signals. The computer system has a 400 gigabyte hard disk.

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Each image size is 400 kilobytes (0.4 gigabytes).
(i) How many images can be stored before the hard disk is full?

Q40) Computer memories are measured in terms of the number of bytes.

(i) What is meant by the term byte?
(ii) What is meant by a Gigabyte?
(b) Flash memories and CD-RWs are used as backing media for computers. Give two differences between these two media.

Q41) The following statistics refer to a music track being recorded on a CD:

• music is sampled at 44 100 times per second
• each sample is 16 bits
• each track requires separate sampling for left and right speakers of a stereo recording

(8 bits = 1 byte, 1 megabyte = 1 048 576 bytes)

(a) (i) How many bytes are required to represent one second of sampled music?
(ii) If a typical music track is 3 minutes long, how much memory is used on the CD to store one track? (Give your answer in megabytes.)

PATEL

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Monitoring & Control System

Sensors and actuators

Sensors and **actuators** are devices that are used for automatic input and control in real-time systems.

Sensors are electronic devices which generate signals in the response of an event like if temperature increases beyond of a certain set limit temperature sensor generate signals and send to processor. The signals generated by sensors are generally in analogue form and need to be converted into digital form so as processor can understand it. **ADC (Analogue-to-Digital Converter)** is used to convert these analogue signals into digital signals.

Actuators are parts of machine which are controlled by processor. The processor sends digital signals, which are converted into analogue signals using **DAC (Digital-to-Analogue Converter)** so as actuator can act upon it.

Sensors (general) in control and measuring applications

Temperature sensor	Automatic washing machines, automatic cookers, central heating controllers, computer-controlled greenhouses, scientific experiments and environmental monitoring
Pressure sensor	Burglar alarms, automatic washing machines, robotics, production line control, scientific experiments and environmental monitoring
Light sensor	Computer controlled greenhouses, burglar alarm systems, robotics, production line control, scientific experiments and environmental monitoring
Graphics tablet	Inputting freehand drawings or retouch photographs
Optical Mark Reader	Inputting pencil marks on a form such as a school register, candidate exam answers, any application involving input of a choice of options
Optical Character Reader	Inputting text to a computer ready for processing by another software package such as word processors, spreadsheets, databases etc.
Bar code Reader	Inputting code numbers from products at a POS terminal, library books and membership numbers
Video camera	Inputting moving pictures, often pre-recorded, into a computer
Web cam	Inputting moving pictures from a fixed position into a computer
Light pen	Where desktop space is limited, it is used instead of a mouse or for drawing applications where a graphics tablet might be too big

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Q42) Summer 2006 P1

Data-logging is used for monitoring the level of oxygen in a river.

(a) State one item of hardware that is used to collect the oxygen data. [1]

(b) Explain how the oxygen data is processed by the computer. [2]

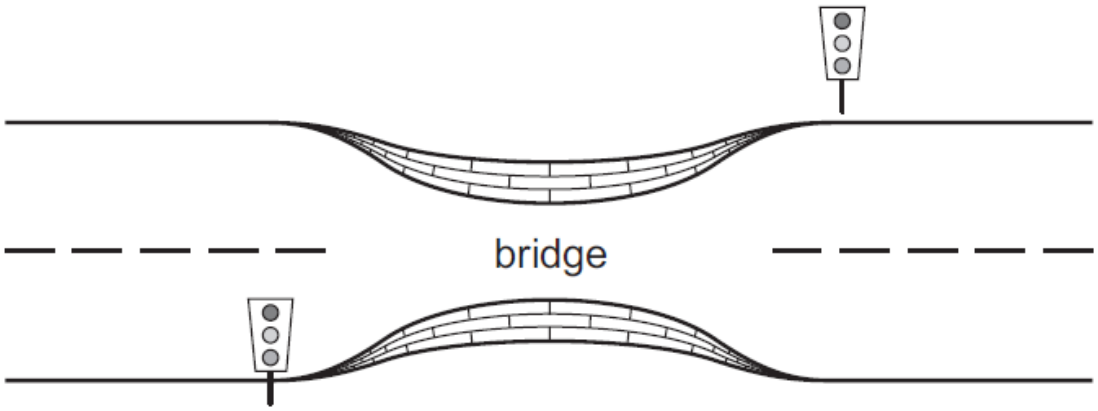
(c) State two ways that the oxygen data could be displayed for a user to understand. [2]

(d) Explain what the computer would do if the amount of oxygen in the water is too high[1]

(e) Give two advantages of using data-logging for monitoring the oxygen data in a river[2]

Q43) Winter 2006 P1

A computer is used to control the traffic lights at each end of a narrow bridge.



(a) State one type of sensor that could be used to detect a vehicle approaching the bridge. [1]

(b) Give one reason why an analogue to digital converter (ADC) may be needed. [1]

(c) Describe how the data received from the sensors is used to control the timing of the traffic lights. [3]

(d) If the computer controlling the traffic light system detects an error in the system, or fails completely, what should the lights on the bridge do? [1]

Q44) Summer 2007 P1

Modern car engines use fuel injection systems which are controlled by microprocessors called Engine Control Units (ECUs). The fuel injection system controls the amount of fuel that goes into the engine. Sensors monitor engine conditions and feed the data back to the ECUs.

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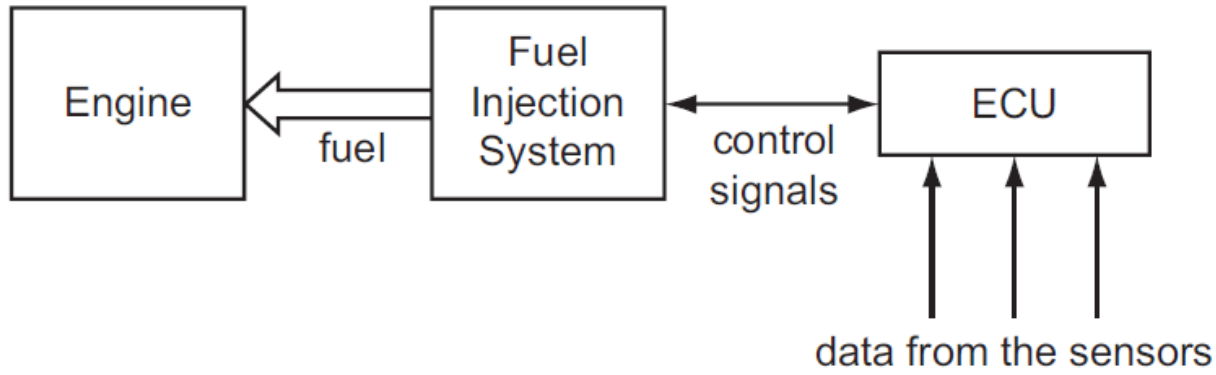

(a) Name two types of sensors used to monitor engine conditions. [2]
(b) Describe how information from the sensors is used to control the fuel injection system [3]
(c) Give an advantage of using automatic fuel injection systems rather than simple mechanical fuel devices. [1]
(d) The fuel injection system operates in real time.
Why would batch processing not be appropriate in this application? [1]

Q45) Winter 2007 P1

Monitoring of patients' vital signs (e.g. heartbeat) in a hospital is done automatically using sensors and computer hardware. Readings are shown on a screen both as a graph and as numbers.
(a) Why are readings shown in both graphical and numerical form? [2]
(b) When the heartbeat is being monitored, how does the system decide if the doctor/nurse needs to be warned of an abnormal reading? [1]
(c) Give two advantages of using this type of automatic monitoring. [2]
(d) How does this monitoring system differ from a control system? [1]

Q46) Summer 2008 P1
The washroom in a hotel uses lights controlled by a computer system. If the washroom is unoccupied for 10 minutes, the lights go out automatically. As soon as someone enters, the lights come on.
(a) How can the system determine if anyone is in the washroom? [2]
(b) Write down a set of instructions which would enable the computer to decide when to turn out the lights. [3]
(c) Give one advantage of this automatic system. [1]

Q47) Winter2008 P1

A large city has decided to computerise totally its traffic management system. Traffic lights and electronic road signs are now under automatic computer control.

(a) Sensors are placed around the city to gather information about traffic. Describe what information would need to be gathered. [2]

(b) Describe two ways the information from the sensors could be sent to the central computer which is located several miles away. [2]

(c) Give two advantages of having the traffic in the city controlled in this way. [2]

Q48) Summer2009 P1

Aeroplanes use on-board computer power to allow them to operate more efficiently and safely.

(a) How is data during a flight collected and fed back to on-board computers? [2]

(b) Why are computer systems thought to be safer than human pilots? [2]

(c) However, pilots are still used on all flights. Why is this? [2]

(d) What recent developments have led to more use of computer control in newly designed aeroplanes? [1]

(e) Describe how the computer would know when to make course corrections during a flight. [2]

(f) At the airport, baggage check-ins use bar codes which are read by computers.

(i) What information would be stored on the bar code? [1]

(ii) Why do airports use the bar codes on baggage? [1]

Q49) Winter 2009 P1

How could a computer simulation be used by a supermarket to reduce queuing at checkouts? [2]

(b) The supermarket has decided to fit sensors at the shop entrance to count people coming in and leaving.

(i) What type of sensor would be suitable to detect people? [1]

(ii) How could the supermarket use the information obtained from these sensors? [2]

(c) The supermarket has decided to fit information screens at various locations for customer use. These information screens do not use keyboards.

(i) Give one example of a suitable input device. [1]

(ii) What information could be made available to supermarket customers? [1]

(iii) Give one advantage of using this system rather than displaying signs and notices around the supermarket. [1]

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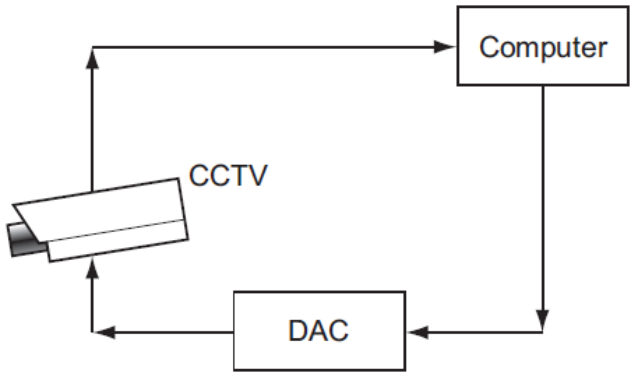
Q 50)A digital security camera was set up as shown in the diagram.



The digital CCTV camera is connected to a computer. The computer can make the camera move in any direction by sending out digital signals. The computer system has a 400 gigabyte hard disk.

(a) What hardware is needed to inform the computer that the camera needs to over to capture an image? [1]

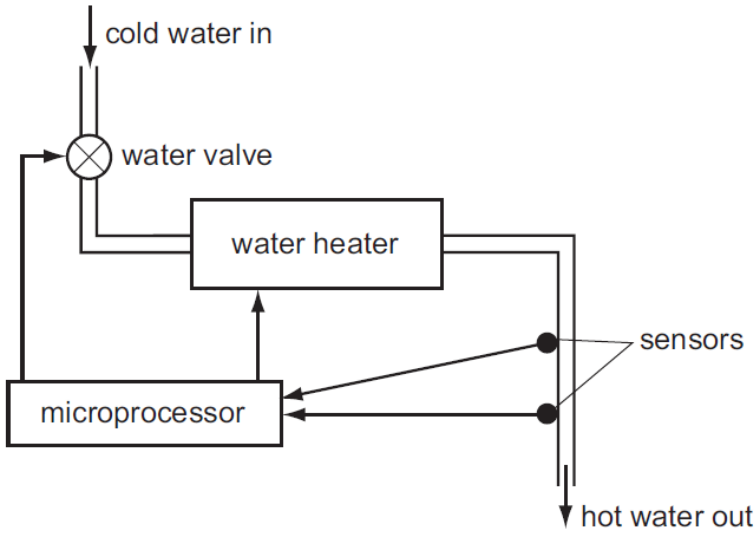
(b) Why is the DAC needed? [1]

(c) How could the computer use the camera to detect an intruder? [1]

(d) Give two advantages of using digital cameras. [2]

Q51) Summer 2010 P11

A shower unit is controlled by sensors and a microprocessor.



(a) Describe how the sensors and microprocessor are used to ensure the correct water flow and water temperature are maintained. [4]

(b) Give one safety feature that could be built into the shower unit in case the sensors and/or microprocessor fail. [1]

(c) What is the advantage of having microprocessor control rather than manual control of water flow and temperature? [1]

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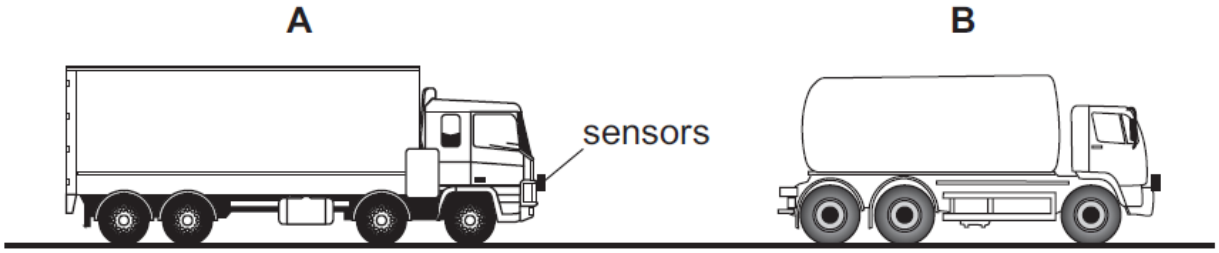
Q52) Summer2010 P12

A safety system has been developed to stop vehicles getting too close to each other on the road.



If vehicle A gets too close to vehicle B, the brakes are automatically applied by a computer system in vehicle A.

(a) What type of sensors could be used on the vehicles? [1]

(b) Describe what the safety system does to constantly monitor how close the vehicle is to the vehicles in front and decide when to take action. [4]

(c) Describe two potential problems with this safety system. [2]

Q53) Winter2010 P12

A road system is to be operated using computer-controlled traffic lights. Sensors are used as part of the control system.

(a) The movement of traffic throughout the road system was first simulated on a computer.

Describe what data would need to be collected and how it would be used in the simulation. [3]

(b) Give two advantages of carrying out a simulation first before introducing a new system. [2]

(c) Describe how the sensors, traffic lights and computer interact to control the traffic following the new system. [2]

Q54) Summer2011 P11

Many computer-controlled systems use sensors to gather physical data. For example, temperature sensors are used in the control of central heating systems.

(a) Name three other sensors and give a different application for each named sensor. [6]

(b) Describe how temperature sensors are used in computer-controlled central heating systems. [3]

Q55) Winter2011 P12

The conditions in a fish tank are being controlled using sensors and a microprocessor. To keep the fish healthy, the temperature must be at 25°C and the oxygen content needs to be20 ppm (parts per million). The tank contains a heater and an oxygen inlet controlled by a valve.

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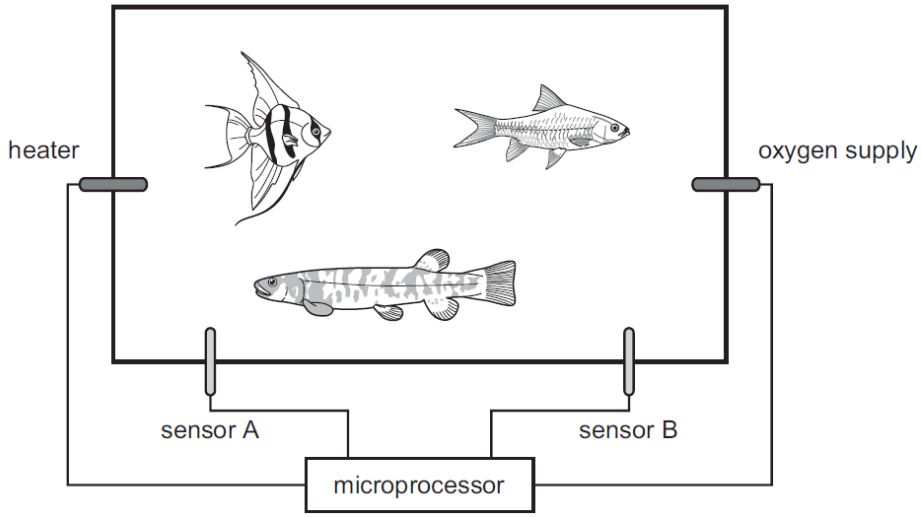
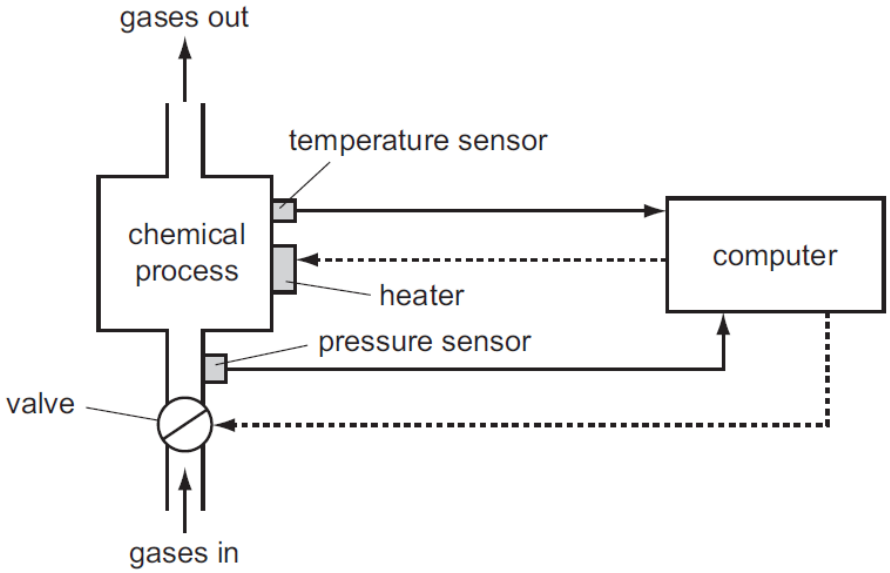


(a) Name the two sensors used in this application. [2]
(b) Describe how the sensors and the microprocessor are used to maintain the correct conditions in the fish tank. [4]
(c) What safeguards would be needed to stop the fish tank temperature rising too high?[1]

Q56) Winter 2011 P13 (7010)
A computer system is being used to monitor and control a chemical process.



(a) Data are collected from sensors at regular intervals and compared with stored values.
(i) Describe how the computer uses this data when monitoring the chemical process.[1]
(ii) Describe how the computer uses this data when controlling the chemical process.[1]
(b) What steps are necessary for the computer to control the temperature of the chemical process? [3]
(c) Name two other sensors and give a different application where they are used.

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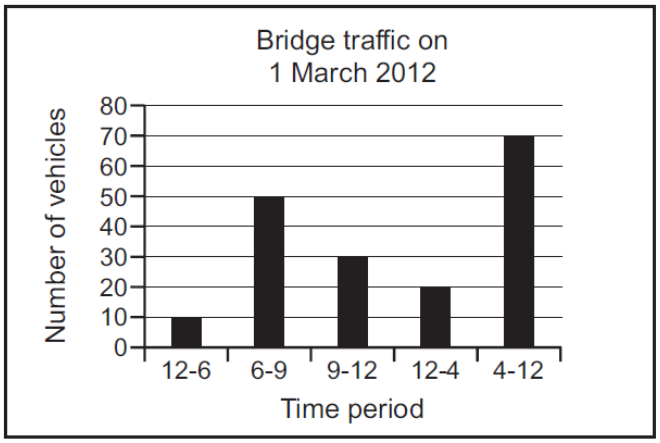
Q57) Summer 2012 P11

Vehicles passing over a bridge are detected automatically using sensors and a computer.

(a) What sensors could be used? [1]

(b) The graph below shows the number of vehicles counted during certain periods of the day.

This graph is produced automatically at the end of each day.



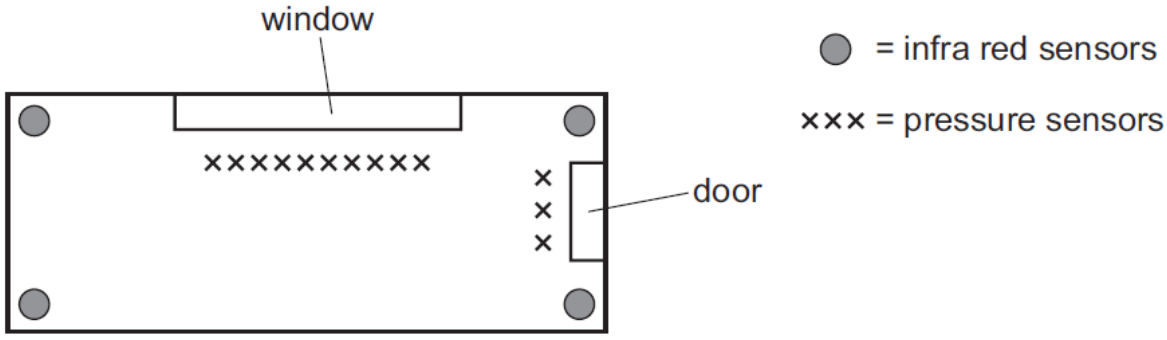
A record is created each time a vehicle is detected. These records are processed to generate the graph and for other purposes.

What data need to be stored in each record? [2]

(c) State two other methods of automatic data capture. In each case, name an application which would use this method. [4]

Q58) Summer 2012 P12

A room in a house is fitted with a computerised intruder alarm system:



(a) (i) Describe how the sensors and computer would be used to detect intruders.

(ii) Describe how the system warns that an intruder has been detected. [4]

(b) It is decided to automatically close door and window shutters if an intruder is detected.

What additional processing and hardware would be needed? [2]

(c) Name another sensor that could have been used in this intruder alarm system.[1]

(d) What measures could be taken to stop or minimise the number of false alarms?[2]

Q59) Winter2012. P12

13 A chemical company uses pipes to transfer hazardous liquids. To protect the workforce, each pipe is inside a protective pipe.

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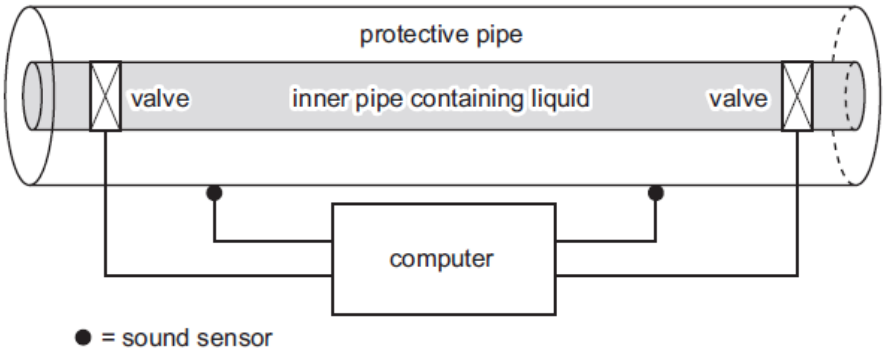

Sensors are used to detect the sound of any liquid dripping into the protective pipe.
Actuators operate the valves that regulate the flow of liquid through the inner pipe.
This system is controlled by a computer.
(a) Describe how the sensors, actuators, valves and computer are used to monitor and control the liquid in the pipe. [5]

(b) Give two advantages of using this computer-controlled system rather than visual checks by the workforce. [2]

Q60) Summer 2013 P11
Name a suitable sensor for each of the following applications.
Choose a different sensor in each application.
(i) control of a central heating system
(ii) operation of automatic doors
(iii) detection of intruders
(iv) monitoring of a greenhouse environment [4]
An aeroplane uses three separate computer systems to monitor and control the flight process while in auto pilot mode.
(a) Explain the advantages of using three computers rather than just one. [2]
(b) Sensors are used to measure air speed. The readings are sent to the three computers.
Describe how the sensors and computers are used to control the aeroplane's speed in auto pilot mode. [4]

Q61) Winter 2013. P13
Patients in a hospital are monitored for vital signs (for example, heart beat and temperature) by sensors and a computer system. Results are displayed on a monitor in the form of numbers and graphs.
(a) Describe how the sensors and computer system are used to monitor the patients and to alert doctors and nurses of a possible problem. [3]
(b) Give two advantages of using this system rather than 24 hour monitoring by nurses.[2]
(c) Why is the output shown in both graphical and numerical form? [2]

Marking Scheme

Q2) – direct access because of concentric tracks
– can read and write at the same time because it has a read/write head [2]
Q3) (a) (i) Any one from:
– unit of data/memory
– 8 bits
– used to represent a character [1]
(ii) Any one from:
– 2^{30} bytes
– 1 073 741 824 bytes
– 1 048 576 kilobytes
– 1024 megabytes [1]
(b) Any two from:
Flash memory
– solid state memory
– no formatting issues
– plugs directly into the USB port
– direct transfer of data
CD-RW
– optical media
– slower access speed/flash memory has faster access speed
– requires a separate drive
– data needs to be burnt/finalised/finished (before being used on another device) [2]
Q 7)

(b) (i) Any one disadvantage from:
– memory size in mobile phone is usually much smaller
– many MP3 features (e.g. shuffle) not available on the mobile phone
– track/song can be interrupted by an incoming call on a mobile phone [1]
(ii) Any one disadvantage from:
– poorer quality of image due to phone's inferior camera lens/fewer pixels /lower resolution
– stores fewer pictures
– fewer photographic options [1]
Q15) 10(a) 90% reduction – so memory space required is ~ 4.5 Mbyte
(b) DVD features:
- Dual layering
- Higher density of data storage is possible
(c) Reasons for increase in usage of CDs/DVDs:
- Greater capacity (can store multimedia files)
- More robust technology (harder to damage)
- Longer "shelf life" if stored properly

Q16) (a) (i) – as first character(s) keyed in, rest of word predicted /word(s) suggested according to the letter(s) already entered [1]
(ii) Any two from (items below are only examples):
– MP3 player
– Bluetooth
– Wi-Fi
– Camera

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– Internet surfing
– GPS [2]
(b) 1 mark for each part:
(i) – less expensive/cheaper than other telephone systems
– can use webcams to have visual as well as text/speech
(ii) – poor quality/drop out/echoes are very common problems
– need to have fast broadband connection to work effectively
(iii) – microphone and speaker/headphones
– Headset [3]

Q16) (a) *download speed any one from:*
– Speed at which information/data is transferred FROM server/Internet
– Speed at which information/data is transferred TO the user's computer
Upload speed any one from:
– Speed at which information/data is transferred FROM user's computer
– Speed at which information/data is transferred TO the Internet/server [2]
(b) Any two from:
– can use Internet connection and telephone at the same time
– Much faster data transfer speed
– Always "on"
– charged for number of bytes/flat rate per month rather than actual time on line
– More bandwidth [2]
(c) Any two from:
– When transferring large files/attachments with emails
– When streaming music/video files/bit streaming
– When using VoIP/video conferencing
– Software updates
– Online transactions
– Using VLE (Virtual Learning Environment) [2]
(d) 128 Mbits/sec = 16 Mbytes/sec
Therefore, FOUR (4) files could be downloaded [1]

Q17) consume little power ….
…. hence prolonging internal battery life
Run cool ….
…. thus minimizing problem of heat dissipation
No processor fans required ….
…. therefore prolonging internal battery life

Q18) (b) Any two from:
data gloves
data goggles/visors
special suits fitted with sensors
(c) Any two from:
3D output of the surroundings
sound effects
smells/simulated smells
movement

Q19)

(i) 400/0.4 = 1000 images
alternative answer 400/0.0004 = 1 000 000 images approx (1 048 576 exactly)
(ii) store images on another hard drive or on DVD/CDs archive old images

Q20) *(ii) any two from*

Safety reasons (in case of fire, for example)
How many check-outs to open
Check on how many customers use s/market at different times
Feed information into simulation/model

Q21)*viruses e.g.*
– use anti-virus software // regular virus scans
– don't open/use disks // don't open email attachments from unknown sources
Hacking e.g.
– Passwords / user IDs
– Firewalls

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Spyware e.g.
– Anti-spyware software
– delete cookies at end of session
Phishing e.g.
– don't open emails from unknown sources
– don't divulge personal information via email / unsecure website
– ensure that the site viewed has a valid security certificate (SSL)
Tapping into wireless networks e.g.
– Secured wifi network (protected by passwords)
– Encryption / WEP *[5]*

Q22)*Any one benefit and one drawback from:*
(a) benefit:
(b) – can bank at any time 24/7

– save money on travelling
– save time not travelling to bank
– can bank from anywhere
– can do transactions/look after account
Drawbacks:
– need computer equipment/internet
– fear of hacking, viruses, etc.
– Lack of one to one with bank
– Creation of "ghost towns"
– reduced socializing
– Cause of redundancies
– Possibility of mismanaging account
– Lack of counter services (drawing out cash) [2]
(b) Any one from:
– stops hackers getting all of the PIN characters

Q23) *email*
Advantages (one from :)
– Easier to send attachments
– Easier/faster to type
– can format text
– Cheaper to send an email
Disadvantage (one from :)
– need to buy computer equipment
– Computer equipment not as portable as mobile phone
– need a broadband connection/modem/Internet access
– need account for emails
– can send a virus
Mobile phones
Advantages (one from :)
– Completely portable method/can be used on the move
– More people have mobile phones
– Use of predictive texting
– Cheaper to buy a phone
Disadvantage (one from :)
– can't send large documents/files/limited number of characters
– Phone charges for sending messages are relatively high
– Phone charges for sending messages overseas are high
– slow to key in messages/small keyboard
– Often out of range of signal/poor signal
– Smaller screens

Q24) *Any five from:*
– viruses
– hacking
– cookies
– pharming
– phishing
– spyware
– tapping into unsecured wifi network/war driving
– shoulder surfing/over-the-shoulder observation of the Internet user's credentials/user name and password

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Q33) *(a) (i) 3 minutes = 180 seconds*
*each song = 180 * 128 = 23 040 kbits*

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number of bytes = 23 040/8 = 2880 kbyte
= 2.8(125) Mbyte [2]
*(ii) 4 Gbyte = 4 * 1024 = 4 096 Mbyte*
therefore, number of songs = 4 096/2.8125 = 1456 songs [2]

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1.3.6 Operating systems

1.3.6 Operating systems • describe the purpose of an operating system • show understanding of the need for interrupts

An *operating system* (**OS**) is software that manages computer hardware and software resources and provides common services for computer programs.

The operating system is an essential component of the system software in a computer system. Application programs usually require an operating system to function.

Not all computers have operating systems. The computer that controls the microwave oven in your kitchen, for example, doesn't need an operating system. It has one set of tasks to perform, very straightforward input to expect (a numbered keypad and a few pre-set buttons) and simple, never-changing hardware to control. For a computer like this, an operating system would be unnecessary baggage, driving up the development and manufacturing costs significantly and adding complexity where none is required. Instead, the computer in a microwave oven simply runs a single hard-wired program all the time.

For other devices, an operating system creates the ability to:

- serve a variety of purposes
- interact with users in more complicated ways
- keep up with needs that change over time

All desktop computers have operating systems. The most common are the Windows family of operating systems developed by Microsoft, the Macintosh operating systems developed by Apple and the UNIX family of operating systems (which have been developed by a whole history of individuals, corporations and collaborators). There are hundreds of other operating systems available for special-purpose applications, including specializations for mainframes, robotics, and manufacturing, real-time control systems and so on.

In any device that has an operating system, there's usually a way to make changes to how the device works. This is far from a happy accident; one of the reasons operating systems are made out of portable code rather than permanent physical circuits is so that they can be changed or modified without having to scrap the whole device.

Functions of an OS

The main functions of a computer's operating system are to:

• complete its own loading into RAM when the computer is started up using a small firmware program stored in ROM or FLASH memory

• manage user accounts and security

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• provide an interface for the user
• control the application programs
• manage the processor's time
• manage the allocation of internal memory
• control peripheral devices keyboards, printers and hard disk drives
• provide 'spooling' – temporary storage of input or output data for relatively slow peripherals
• manage interrupt signals to the processor
• perform housekeeping tasks, such as file indexing or defragmenting a HDD drive.

Types of operating system

Types of operating system, which are not mutually exclusive, include:
• a batch OS
• a multi-tasking OS
• a multi-access OS
• a real-time OS of which there are two types:
– a real-time transaction processing OS
– a real-time process control OS
• a network OS.

User interface

A user interface, or human-computer interface (HCI), consists of all the hardware and software through which a user provides input to a computer or receives information from it. Types of user interface controlled by the OS include:

- **Command Line Interface**
- **A Graphical User Interface**:

A Command Line Interface (CLI):

A command-line interface allows the user to interact with the computer by typing in commands. The computer displays a prompt, the user keys in the command and presses enter.

In the early days of personal computers, all PCs used command-line interfaces.

Features of a command-line interface

- Commands must be typed correctly and in the right order or the command will not work.
- Experienced users who know the commands can work very quickly without having to find their way around menus.

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- An advantage of command driven programs is that they do not need the memory and processing power of the latest computer and will often run on lower spec machines.
- Command driven programs do not need to run in Windows.
- A command-line interface can run many programs, for example a batch file could launch half a dozen programs to do its task.
- An inexperienced user can sometimes find a command driven program difficult to use because of the number of commands that have to be learnt.

An example of a common command driven interface is **MS-DOS**. The MS-DOS command to display all files on c:\ would be: **dir c:**

A Graphical User Interface:

Graphical user interface is sometimes shortened to **GUI**. The user chooses an option usually by pointing a mouse at an icon representing that option.

Features of GUIs include:

- They are much easier to use for beginners.
- They enable you to easily exchange information between software using cut and paste or 'drag and drop'.
- They use a lot of memory and processing power. It can be slower to use than a command-line interface if you are an expert user.
- They can be irritating to experienced users when simple tasks require a number of operations.

When discussing user interfaces, it is important to note that Windows XP, Windows Vista, Apple OSX and Ubuntu all have **graphical user interfaces**.

Good user interfaces

A good user interface should:

- be attractive and pleasing to the eye
- allow the user to try out different options easily
- be easy to use
- use suitable colours for key areas
- use words that are easy to understand aimed at the type of user
- have help documentation

It should also consider the needs of the users. For example, young children are likely to prefer pictures to words and people with disabilities may benefit from particular input or output devices.

```
Select an option:

1. Start in MS DOS mode
2. Start Windows
3. Run system check
4. Shut down and log off
```

A Menu Driven Interface:

The user is offered a simple menu from which to

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choose an option. One menu often leads to a further menu. Part of the screen may have an instruction followed by a numbered list of options to choose from.

File management

A file is a program or set of data saved in backing storage.

Directories, sub-directories and folders

A file directory is an index of the contents of a storage drive or sub-directory (a subset of the drive's contents). A GUI of en represents a directory as a folder.

Commands for file management

- listing, sorting and searching the contents of a storage drive or folder
- moving contents between drives or folders
- copying contents between drives or folders
- printing a file without having to open it in an application program window.

Peripheral device control

Methods of communication between the OS and peripheral devices include the use of:

- **Buffers:** Temporary memory area in memory used to compensate the difference in speed of two devices.
- **Spooling:** Acronym for ***s****imultaneous* ***p****eripheral* ***o****perations* ***on-line****, spooling* refers to putting jobs in a buffer, a special area in memory or on a disk where a device can access them when it is ready. Spooling is useful because devices access data at different rates.
- **Interrupts**: A signal sent from a peripheral device (hardware) or program event (software) to the printer to indicate that the sender needs attention.
- **Polling**: The process carried out by an operating system of periodically interrogating each peripheral device in turn to discover whether it needs the attention of operating system.
- **Handshaking**: The process by which two devices negotiate the protocol, (rules) they will use to communicate for the rest of the session, or signal their readiness to send or receive data.
- **Checksum**: A summary value that is calculated from a block of data.

Examination Questions

Q1) Summer 2014 P11:

(a) (i) A student wrote: "batch processing can be used when making airline bookings". Why is this statement incorrect? [1]

_____

_____

_____

_____

(ii) The same student also wrote: "to launch an application, a graphical user interface

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(GUI) requires typing the name of the application using a keyboard".
Why is this statement incorrect? [1]

.....

.....

.....

(b) A user interface is a function of a typical operating system.
Write down four other functions of a typical operating system.

1: _____

2: _____

3: _____

4: _____ [4]

Q2) Summer 2011

Most operating systems provide a user interface.
(a) User interfaces can be either command line interfaces (CLI) or graphical user interfaces (GUI). Give ONE advantage and ONE disadvantage of both types of interface.
Advantage CLI:
Disadvantage CLI:
Advantage GUI:
Disadvantage GUI: [4]

(b) Give THREE other tasks carried out by an operating system.

1: _____

2: _____

3: _____ [3]

Q3) 9691_13w_qp11

(a) What is meant by an interrupt?

_____

_____

_____ [1]

(b) A user starts the printing of a document, and then carries on editing a second document while printing continues.
Explain how interrupts make this possible.

_____

_____

_____

_____

_____ [4]

(c) Once a week the user runs a virus checker.
What action will be taken if the virus checker detects a virus in a file?

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.....

..... [2]

(d) The computer is running a single-user operating system.
Describe what this means.

_____

_____

_____ [2]

Q4) 9691_13s_qp11

(a) Describe the terms buffer and interrupt.

Buffer: _____

_____ [2]

interrupt: _____

_____

_____ [2]

(b) (i) Explain the role of the buffer and interrupts when a large document of over 200 pages is sent to a laser printer.

_____

_____ [3]

(ii) The use of two buffers would speed up the printing process. Explain why.

_____

_____

_____ [2]

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1.3.7 High- and low-level languages and their translators

1.3.7 High- and low-level languages and their translators
• show understanding of the need for both high-level and low-level languages
• show understanding of the need for compilers when translating programs written in a high-level language
• show understanding of the use of interpreters with high-level language programs
• show understanding of the need for assemblers when translating programs written in assembly language

Programming Language:

"A set of rules that provide a way of telling computer what operation to perform is called a Programming Language."

Computer needs instructions to perform a task. Program is set of step by step instruction which directs computer to do the task and to produce results. There are some rules and regulations to write programs and these rules and regulations are programming languages.

Different types of programming languages are given below:

1) **Machine Language: (Low Level Language)**

Machine languages are the most basic languages. They consist of a series of current signals 'On' and 'Off'. On is represented by '1' and off is represented by '0'. It is 1st generation of language.

Machine language is also called Binary Digits. It is computer's language in which different parts of computer communicate with each other. 0s and 1s are called bit (binary digit).

Machine language is easy for computer and difficult for programmer. Every computer has its own unique machine language. It means machine for Apple Macintosh is different from IBM compatible.

Machine Language Code
00010010111101010100111101010
01000100110000111110101011110
00111100010101010010100001111
10101010111101010001111101011

2) **Assembly Language: (Middle Level Language)**

Assembly language consists of English like symbolic codes known as mnemonics. It is a second generation of language.

They represent common strings of machine codes. A language translator, Assembler, is used to convert source code of Assembly language program into object code of machine language. Though Assembly languages are easier than machine language but they are highly detailed and cryptic. So programmers seldom write programs in Assembly language. Instead programmers use Assembly languages to fine-tune important parts of programs written in a high level language.

Assembly Code (Source code)
ADD R1 #6 #12 DIV R2 R1 #2 STO R2000 R2

3) **High Level Languages**

High-level languages consist of familiar English words as result programmers can read, write and understand programs easily.

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A language translator (compiler or interpreter) translates source code of High Level Language into object code. That's why the program of High Level Language can be executed on any machine.

High Level Code (Source code)
For Count=1 to 10 Print "Allah" Next Count

Examples: COBOL, Pascal, FORTRAN, GWBASIC, C++, JAVA, VB.Net.

Source Code:

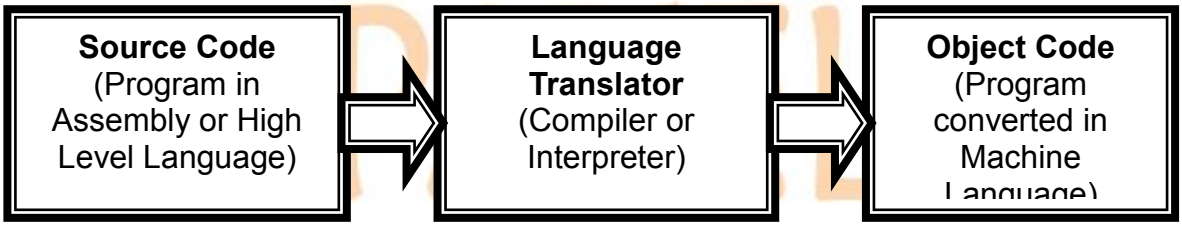
"A program written in any language except the machine language is called Source Code."

Programmers can write programs in Machine Language, Assembly Language and High Level Languages like COBOL, PASCAL, and GWBASIC etc. The programs, written in Assembly Language or any High Level Language are called Source Code.

Object Code:

"A program written in Machine Language is called Object Code."

Computer can understand only machine language code. Language translators converts source code of High Level Language into machine code, these converted codes are Object Codes.



Language Translator:

"Language Translators are programs that convert or translate the instructions in Assembly Language or High Level Language i.e. source code into instructions of machine language i.e. object codes are called Language Translators."

Computer can understand only machine language. Programs written in Assembly Language and High Level Language are translated into Machine Language so as computer can understand execute them.

Following are three types of language translators:

1 Assembler:-

"Assembler is a language translator that translates source program written in Assembly Language into object code in machine language."

Computer can understand only machine language. Assemblers translate programs written in Assembly Language into Machine Language so as computer can

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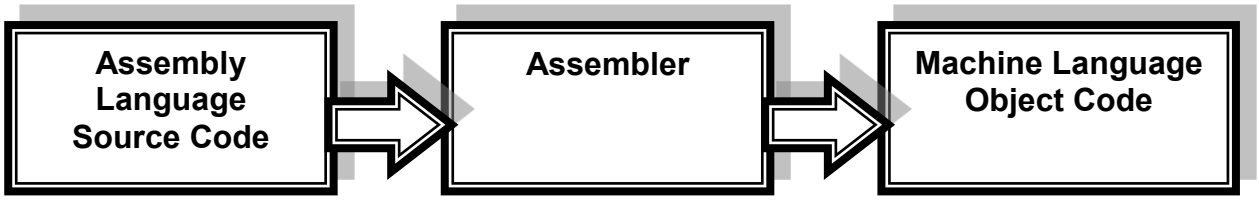
understand execute them.



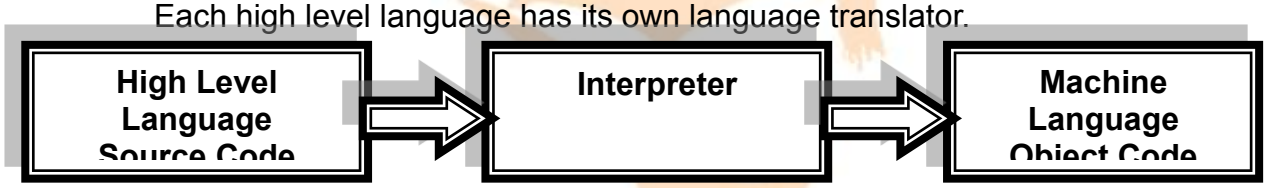
2 Interpreters:-

"An interpreter is a language translator that translates source program written in High Level Language into object code in machine language during step by step execution of program."

Computer can only understand instruction written in machine language. Interpreters translate one by one instruction of High Level Language source code into object code of Machine Language.

Interpreter translates one instruction which is executed before translation of next instruction. The object code is not saved so the source code is interpreted every time before the execution.

Each high level language has its own language translator.



3 Compilers:-

"A compiler is a language translator that translates whole source program written in High Level Language into object code in machine language before execution of program."

Compilers translate all instructions before executions. The object code is saved as object file, which is executable. Object files don't need compiler or language for execution.

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1.4, 1.5, 1.2.2 Security aspects Security &Computer Ethics

1.4.1
• show understanding of the need to keep data safe from accidental damage, including corruption and human errors
• show understanding of the need to keep data safe from malicious actions, including unauthorised viewing, deleting, copying and corruption
1.4.2
• show understanding of how data are kept safe when stored and transmitted, including:
○ use of passwords, both entered at a keyboard and biometric
○ use of firewalls, both software and hardware, including proxy servers
○ use of Secure Socket Layer (SSL)
○ use of symmetric encryption (plain text, cypher text and use of a key) showing understanding that increasing the length of a key increases the strength of the encryption
1.4.3
• show understanding of the need to keep online systems safe from attacks including denial of service attacks, phishing, pharming
1.4.4
• describe how the knowledge from 1.4.1, 1.4.2 and 1.4.3 can be applied to real-life scenarios including, for example, online banking, shopping
show understanding of computer ethics, including copyright issues and plagiarism
• distinguish between free software, freeware and shareware
• show understanding of the ethical issues raised by the spread of electronic communication and computer systems, including hacking, cracking and production of malware

Data Integrity

Data integrity refers to maintaining and assuring the accuracy and **consistency** of **data** over its entire life-cycle, and is a critical aspect to the design, implementation and usage of any system which stores, processes, or retrieves **data**.

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Data security is about keeping data safe. Many individuals, small businesses and major companies rely heavily on their computer systems.
If the data on these computer systems is damaged, lost, or stolen, it can lead to disaster.

Key threats to data security

Data may get:

- lost or damaged during a system crash - especially one affecting the hard disk
- corrupted as a result of faulty disks, disk drives, or power failures
- lost by accidentally deleting or overwriting files
- lost or become corrupted by computer viruses
- hacked into by unauthorised users and deleted or altered
- destroyed by natural disasters, acts of terrorism, or war
- deleted or altered by employees wishing to make money or take revenge on their employer

Keeping data secure

Measures that can be taken to keep data secure include:

- making regular backups of files (backup copies should be stored in fireproof safes or in another building)
- protecting yourself against viruses by running anti-virus software
- using a system of passwords so that access to data is restricted
- safe storage of important files stored on removable disks, e.g. locked away in a fireproof and waterproof safe
- allowing only authorised staff into certain computer areas, e.g. by controlling entry to these areas by means of ID cards or magnetic swipe cards
- always logging off or turning terminals off and if possible locking them
- avoiding accidental deletion of files by write-protecting disks
- using data encryption techniques to code data so that it makes no apparent sense

Online banking

When you bank online, after you've logged in, you will notice that the http in the address bar has changed to **https**. This indicates that a secure connection between your computer and the bank's computer has been established. Data sent between the two computers is encrypted so that anyone trying to intercept your data will receive meaningless data. The data can only be decrypted into readable data by using a key that is known only to the two computers - yours and the bank's.

Examination Questions

Exam questions on data security will usually ask about methods for keeping data safe and secure.

Question

In a local doctor's surgery, data about the patients is stored in a database on a computer.
Consider two physical precautions that should be taken to keep the data secure.

Answer

1. keep the computer area secure
2. keep backups in a safe place

Examiner's comment

The key word is **physical** - the question is asking for the physical precautions you can take to protect data. Keeping the computer area secure and keeping backups in a safe place are both physical precautions. Swipe card entry, locking terminals or controlling access to computer areas would also have been good answers.

Question

The doctor needs to see all the information about patients. The receptionist only needs to see some of the information.

Describe one way in which software could restrict access to patient information.

Answer

Make it so users must enter a password to gain access to certain areas of the database.

Examiner's comment

The question is looking for detail about different types of access for different users. This answer clearly highlights the need for having passwords for different levels of access.

Types of computer misuse

Misuse of computers and communications systems comes in several forms:

Hacking

Hacking is unauthorized use of computer and network resources.

The activity of breaking into a computer system to gain an unauthorized access is known as hacking. The act of defeating the security capabilities of a computer system in order to obtain an illegal access to the information stored on the computer system is called hacking.

Protection:

- Make your passwords long and complicated, and with a good mix of letters and numbers, as well as utilizing case-sensitive letters. Don't use anything familiar, such as your birthday, your children's names or anything like that. If a hacker wants to attempt to break into your email accounts, at least make him work for it.
- Don't ever allow your browser to remember your passwords. True, it may be a bit of an inconvenience to enter your password every time you log in.
- Activate Firewall

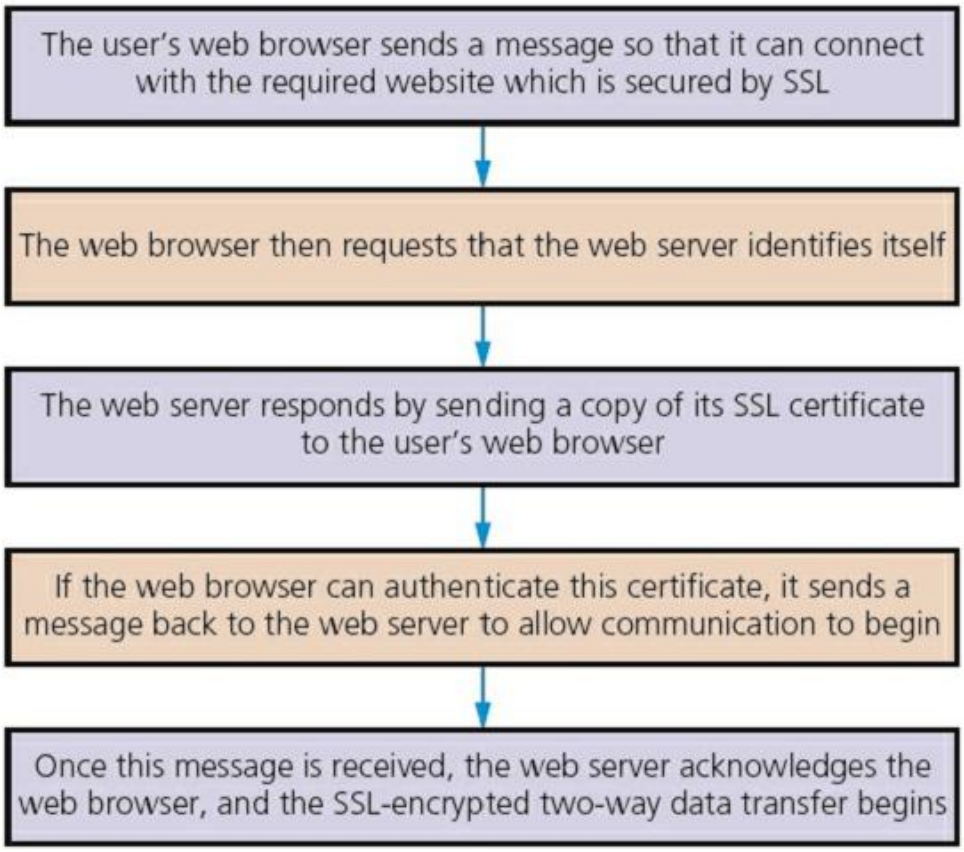
Security protocols

We will now consider two forms of security protocols when using the internet:

- Secure Sockets Layer (SSL)
- Transport Layer Security (TLS).

SECURE SOCKETS LAYER (SSL) is a type of protocol (a set of rules used by computers to communicate with each other across a network). This allows data to be sent and received securely over the internet.

When a user logs onto a website, SSL encrypts the data – only the user's computer and the web server are able to make sense of what is being transmitted. A user will know if SSL is being applied when they see https or the small padlock in the status bar at the top of the screen. So what happens when a user wants to access a secure website and receive and send data to it?



TRANSPORT LAYER SECURITY (TLS) is similar to SSL but is a more recent security system. TLS is a form of protocol that ensures the security and privacy of data between devices and users when communicating over the internet. It is essentially designed to provide encryption, authentication and data integrity in a more effective way than its predecessor SSL.

When a website and client (user) communicate over the internet, TLS is designed to prevent a third party hacking into this communication causing problems with data security.

TLS is formed of two layers:

- Record protocol: this part of the communication can be used with or without encryption (it contains the data being transferred over the internet).
- handshake protocol: this permits the website and the client (user) to authenticate each other and to make use of encryption algorithms (a secure session between client and website is established).Only the most recent web browsers support both SSL and TLS which is why the older SSL is still used in many cases. But what are the main differences

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between SSLand TLS since they both effectively do the same thing?
- It is possible to extend TLS by adding new authentication methods.
- TLS can make use of **SESSION CACHING** which improves the overall performance 158 compared to SSL.
- TLS separates the handshaking process from the record protocol (layer) which holds all the data.

Session caching

When opening a TLS session, it requires a lot of computer time (due mainly to the complex encryption keys being used). The use of session caching can avoid the need to utilise so much computer time for each connection. TLS can either establish a new session or attempt to resume an existing session; using the latter can considerably boost system performance.

Summer 2015 P12

(a) State what is meant by the term SSL.

.....
.....
.....[1]

(b) The following stages take place when a user wishes to access a secure website.
Put each stage in sequence by writing the numbers 1 to 6 in the column on the right. The first one has been done for you. [5]

Stage	Sequence number
the encrypted data is then shared securely between the web browser and the web server	
the web browser attempts to connect to a website which is secured by SSL	**1**
the web server sends the web browser a copy of its SSL certificate	
the web browser requests the web server to identify itself	
the web server will then send back some form of acknowledgement to allow the SSL encrypted session to begin	
the web browser checks whether the SSL certificate is trustworthy; if it is, then the web browser sends a message back to the web server	

Marking Scheme

(a) Any one from:
− Secure sockets layer
− encrypts data being transmitted
− Use of https
− use public and private keys [1]

(b) 1 mark for each number in the correct order, next to the correct stage.

Stage	Sequence number
the encrypted data is then shared securely between the web browser and the web server	6
the web browser attempts to connect to a website which is secured by SSL	**1**
the web server sends the web browser a copy of its SSL certificate	3
the web browser requests the web server to identify itself	2
the web server will then send back some form of acknowledgement to allow the SSL encrypted session to begin	5
the web browser checks whether the SSL certificate is trustworthy; if it is, then the web browser sends a message back to the web server	4

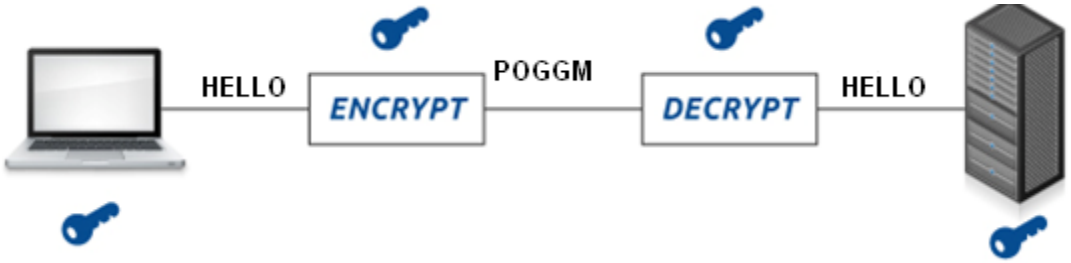
Data Encryption

Encryption is the conversion of electronic data into another form, called cipher text,

which cannot be easily understood by anyone except authorized parties.
The word encryption comes from the Greek word kryptos, meaning hidden or secret.
SSL (Secure Sockets Layer) is standard security technologies for establishing an encrypted links between a server and a client—typically a web server (website) and a browser; or a mail server and a mail client (e.g., Outlook). It allows sensitive information such as credit card numbers, social security numbers, and login credentials to be transmitted securely. To establish this secure connection, the browser and the server need an SSL Certificate.

Symmetric Encryption

Symmetric encryption (or pre-shared key encryption) uses a single key to both encrypt and decrypt data. Both the sender and the receiver need the same key to communicate.

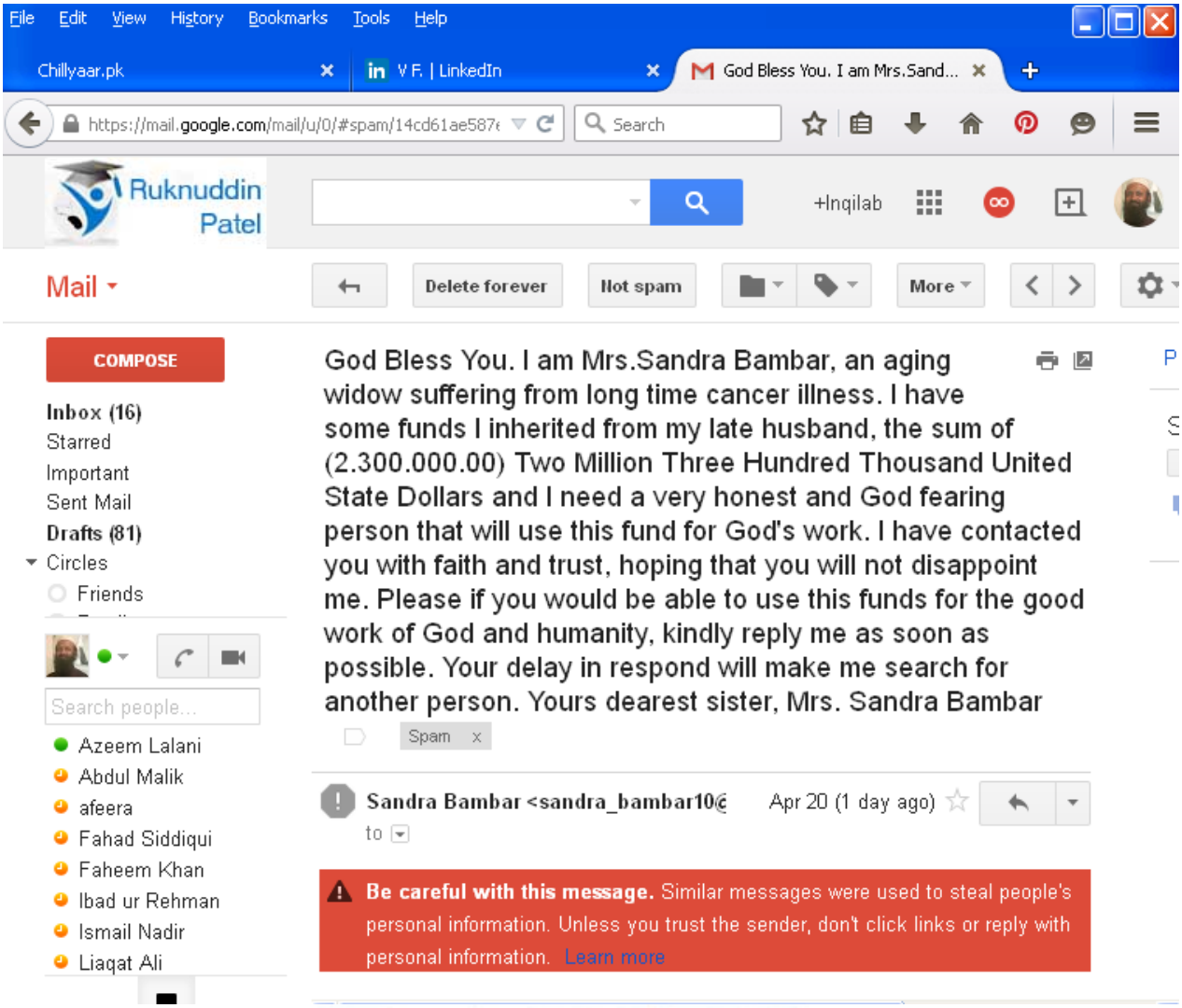


Specimen Paper 2015

Q1) In a simple symmetric encryption system, each letter of the alphabet is substituted with another.
The plain text message:
The quick brown fox jumps over the lazy dog.
becomes the cypher text message:
Zag towns jumpy dmhcoilpmnguzagbfkeqmx.
(a) (i) Decode this cypher text message.
AgbbmPmubq
.....
..... [2]
(ii) Convert these words to cypher text.
Computer Science
.....
..... [2]
(b) Both the person who sends the message and the person who receives it need to know what the substitution key is, and they need to keep this secret. A copy of the substitution key has been sent using SSL transmission.
Explain why this keeps the copy of the key secret during transmission.
.....
..... [2]

Phishing

Phishing is the act of attempting to acquire sensitive information like usernames, passwords and credit card details by disguising as a trustworthy source. Phishing is carried out through emails or by luring the users to enter personal information through fake websites. Criminals often use websites that have a look and feel of some popular website, which makes the users feel safe to enter their details there.



Protection

1. The most powerful weapon against phishing is common sense and the following rules that every user should oblige to.
2. If you are not a customer of the site delete the email immediately. Don´t click on the link or reply.
3. If you are a customer and you are not sure if the email is legit do one of the following:
   1. Contact the institute by phone or contact at the official website (do not use the email link of course) and ask if the mail is official.
   2. Instead of using the link provided open the website by typing in the official link there. The site should have news about the email on their starting page. (Most of the time). If not, use 2a to verify the email.

Pharming:

Pharming in Simple Steps:

Hacker creates a fake website which appears similar to the original website.
Hacker poisons the DNS servers thus domain names are resolved into fake IP address.
User types the URL of the original website in the browser.
The DNS server directs User to the fake website designed by hacker.

User not knowing that it is a fake website, shares his confidential information such as login, password etc.
Hacker gets the user confidential information from his fake web site and uses it to access the original website.
Hacker exploits user's confidential information to his liking.

Protection

Check the URL of any site that asks you to provide personal information. Make sure your session begins at the known authentic address of the site, with no additional characters appended to it.
Use a trusted, legitimate Internet Service Provider. Rigorous security at the ISP level is your first line of defense against pharming.
Check the certificate. It takes just a few seconds to tell if a site you land on is legitimate.
Block suspicious Websites automatically
Internet Business Scam
Dear Friend, Inqilab Patel
as you read this, I don't want you to feel sorry for me, because, I believe everyone will die someday. My name is Mr AdadaMuhammadu, a Crude Oil merchant in Nigeria and I have been diagnosed with Esophageal cancer. It has defied all forms of medical treatment, and right now I have only about a few months to live, according to medical experts. I want God to be merciful to me and accept my soul so, I have decided to give alms to charity organizations, as I want this to be one of the last good deeds I do on earth. So far, I have distributed money to some charity organizations in Austria, Cameroon, Liberia, Algeria and Malaysia. Now that my health has deteriorated badly, I cannot do it myself anymore. The last of my money which no one knows of is the huge cash deposit of Eighty million dollars $80,000,000 that I have with a finance/Security Company abroad. I will want you to help me collect this deposit and dispatched it to charity organizations. I have set aside 20% for you and for your time.
God be with you. ~
Mr AdadaMuhammadu"

Data misuse and unauthorised transfer or copying

Copying and illegal transfer of data is very quick and easy using online computers and large storage devices such as hard disks, memory sticks and DVDs. Personal data, company research and written work, such as novels and textbooks, cannot be copied without the copyright holder's permission.

Copying and distributing copyrighted software, music and film

This includes copying music and movies with computer equipment and distributing it on the Internet without the copyright holder's permission. This is a widespread misuse of both computers and the Internet that breaks copyright regulations.

Email and chat room abuses

Internet services such as chat rooms and email have been the subject of many well-publicized cases of impersonation and deception where people who are online pretend to have a different identity. Chat rooms have been used to spread rumors about well known personalities. A growing area of abuse of the Internet is email spam, where millions of emails are sent to advertise both legal and illegal products and services.

Pornography

A lot of indecent material and pornography is available through the Internet and can be stored in electronic form. There have been several cases of material, which is classified as illegal, or which shows illegal acts, being found stored on computers followed by prosecutions for possession of the material.

Identity and financial abuses

This topic includes misuse of stolen or fictional credit card numbers to obtain goods or services on the Internet, and use of computers in financial frauds. These can range from complex well thought out deceptions to simple uses such as printing counterfeit money with colour printers.

Viruses

Viruses are relatively simple programs written by people and designed to cause nuisance or damage to computers or their files.

How to prevent computer misuse

The Computer Misuse Act (1990)

This was passed by Parliament and made three new offences:

1. Accessing computer material without permission, e.g. looking at someone else's files.
2. Accessing computer material without permission with intent to commit further criminal offences, e. g. hacking into the bank's computer and wanting to increase the amount in your account.
3. Altering computer data without permission, e.g. writing a virus to destroy someone else's data, or actually changing the money in an account.

The Data Protection Act

The Data Protection Act (DPA) is a law designed to protect personal data stored on computers or in an organised paper filing system.

The need for the Data Protection Act

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During the second half of the 20th century, businesses, organisations and the government began using computers to store information about their customers, clients and staff in databases. For example:

- names
- addresses
- contact information
- employment history
- medical conditions
- convictions
- credit history

Databases are easily accessed, searched and edited. It's also far easier to cross reference information stored in two or more databases than if the records were paper-based. The computers on which databases resided were often networked. This allowed for organisation-wide access to databases and offered an easy way to share information with other organisations.

The Data, information and databases section has more on searching databases.

Misuse and unauthorised access to information

With more and more organisations using computers to store and process personal information there was a danger the information could be misused or get into the wrong hands. A number of concerns arose:

- Who could access this information?
- How accurate was the information?
- Could it be easily copied?
- Was it possible to store information about a person without the individual's knowledge or permission?
- Was a record kept of any changes made to information?

The purpose of the Data Protection Act

The **1998 Data Protection Act** was passed by Parliament to control the way information is handled and to give legal rights to people who have information stored about them. Other European Union countries have passed similar laws as often information is held in more than one country.

The Eight Principles of Data Protection

For the personal data that controllers store and process:

1. It must be collected and used fairly and inside the law.
2. It must only be held and used for the reasons given to the Information Commissioner.
3. It can only be used for those registered purposes and only be disclosed to those people mentioned in the register entry. You cannot give it away or sell it unless you said you would to begin with.
4. The information held must be adequate, relevant and not excessive when compared with the purpose stated in the register. So you must have enough detail but not too much for the job that you are doing with the data.
5. It must be accurate and be kept up to date. There is a duty to keep it up to date, for example to change an address when people move.

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6. It must not be kept longer than is necessary for the registered purpose. It is alright to keep information for certain lengths of time but not indefinitely. This rule means that it would be wrong to keep information about past customers longer than a few years at most.
7. The information must be kept safe and secure. This includes keeping the information backed up and away from any unauthorised access. It would be wrong to leave personal data open to be viewed by just anyone.
8. The files may not be transferred outside of the European Economic Area (that's the EU plus some small European countries) unless the country that the data is being sent to has a suitable data protection law. This part of the DPA has led to some countries passing similar laws to allow computer data centres to be located in their area.

The roles of those involved

1. The **Information Commissioner** is the person (and his/her office) who has powers to enforce the Act.
2. A **data controller** is a person or company that collects and keeps data about people.
3. A **data subject** is someone who has data about them stored somewhere, outside of their direct control. For example, a bank stores its customers' names, addresses and phone numbers. This makes us all data subjects as there can be few people in the UK who do not feature in computer records somewhere.

Copyright law

This provides protection to the owners of the copyright and covers the copying of written, musical, or film works using computers. FAST is the industry body which is against software theft. You can find out more about it in the Copyright section.

There have been cases where laws such as Copyright have been used to crack down on file sharing websites or individuals who store and illegally distribute copyrighted material, e.g. music. There is a massive problem with many people around the world obtaining copyrighted material illegally.

Close down chat rooms

Some chat rooms have been closed down due to abuses, especially where children are vulnerable. Some have moderators who help to prevent abuses. Advice about sensible use is important; especially to never give personal contact details or arrange meetings without **extreme caution**.

Reduce email spamming

This may be reduced by:

- never replying to anonymous emails
- setting filters on email accounts
- reporting spammers to ISPs, who are beginning to get together to blacklist email abusers
- governments passing laws to punish persistent spammers with heavy fines

Regular backups and security

Just making something illegal or setting up regulations does not stop it happening. Responsible computer users need to take reasonable steps to keep their data safe. This includes regular backups and sufficient security with passwords.

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Examination Questions
Winter 2014 P12

The following **five** statements about Internet security are incomplete:

(i) Illegal access to a computer system is known as < - - - - - - - - - >.

(ii) < - - - - - - - - - > are programs that self-replicate (copy themselves) and are designed to disrupt computer systems.

(iii) < - - - - - - - - -> is where a user is sent legitimate-looking emails; as soon as the email is opened and the recipient clicks on the embedded link, they are sent to a fake website.

(iv) Software that monitors key presses on a user's keyboard, and relays the information back to the person who sent the software, is known as < - - - -- - - - >.

(v) < - - - - - - - - - > is malicious code or software installed on the hard drive of a user's computer or on a web server; the code or software will re-direct the user to a fake website without their knowledge.

Complete the **five** statements using words from the following list:

• Cookies	• hacking	• pharming	• phishing
• spam	• spyware	• viruses	• web browsers

PATEL

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Summer 2014

The diagram below shows a number of descriptions and terms used in computer security. By drawing arrows, connect the correct description to the computer security term.

Program installed on a PC to gather data about the user. It monitors every key press and relays the data back to the home base.	Cookies
Junk (unsolicited) electronic mail advertising products and services sent to a general mailing list.	Phishing
Sending an email that claims to be from a legitimate company; the recipient is then directed to a bogus website where their personal details will be collected.	Pharming
Malicious code installed on a PC or on a server. This code directs users to a fraudulent website without their knowledge.	Spyware
Act of locating and possibly exploiting a wireless network by touring an area. This requires a laptop with relevant software and an antenna.	Spam
Information that a website stores about a user on the user's hard disk; this enables the website to remember details about the user when they next visit the website.	War-driving

PATEL

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Q3) Five security or data loss issues are shown on the left-hand side.
Five possible methods of data recovery or protection are shown on the right.
Draw a line to match each definition/description of Issues to the most appropriate Methods of Data Recovery.

Issues	Methods of Data Recovery
Data loss caused by hard disk head crash	Anti-spyware software
Hacking into files and changing or deleting data	Anti-virus software
Introduction of software that self-replicates and can cause data loss	Back-up files
Reading of illegally accessed documents	Encryption
Software that logs/records all key presses on your computer without you knowing	Passwords and a firewall

Winter 2014 P13

3 (a) Felipe wrote down the following three statements.
In **each** case, indicate whether the statement is true or false and give a reason for your choice.

"Encrypting data prevents it from being hacked"

TRUE/FALSE .....
.....
Reason .....
.....
.....
.....

"backing up data removes the risk of the data being infected by viruses"

TRUE/FALSE .....
.....
Reason.....
.....
.....

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"Wireless (Wi-Fi) networks are less secure than hard-wired systems"
TRUE/FALSE .....
.....
Reason .....
.....
.....
.....[3]

(b) Felipe uses Internet banking. When he logs on, the website asks for the 1st, 4th and 8th characters in his password. He selects the characters from drop-down boxes.

(i) State why drop-down boxes are used.
.....
.....[1]

(ii) Felipe is also asked to confirm the last date and time when he logged onto the website.
State why he is asked to confirm this.
.....
.....[1]

(iii) When Felipe wishes to return to a previous page on this website, he clicks on the **View My Account** option rather than using the browser arrows. If he uses the browser arrows, he is logged out of the website.
Give a reason why the website does this.
.....
.....
.....[1]

a) FALSE – encryption only stops data being read / making sense (but does not prevent the act of hacking)
FALSE – data when backed up could still have the virus attached to it
– when the backed up data is re-loaded at a later date, the virus could be loaded again into the system together with the stored data
TRUE – tapping into a Wi-Fi network is relatively easy (even when the network is protected by passwords)
(b) (i) drop down boxes help defeat spyware / key logging software [1]
(ii) – to ensure that it was in fact Felipe who logged on last time [1]
– an additional authentication check
(iii) in case it is not Felipe who attempts to access the account[1]

Summer 2011

Q1) (a) Give TWO features you would expect to find in a data protection act.
1
2 [2]

(b) Why would this act still not necessarily protect data stored in a computer system? [2]

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Summer 2014

Q2) An encryption system gives each letter of the alphabet a value:
A = 1, B = 2, C = 3, …… , Y = 25, Z = 26.
Each letter is stored in a 12-bit binary register. The letter "S" (19th letter) is stored as:

2048	1024	512	256	128	64	32	16	8	4	2	1
0	0	0	0	0	0	0	**1**	**0**	**0**	**1**	**1**

A 4-bit register is used to store the encryption key. This register shows how many places the bits are shifted to the left in the 12-bit register when it is encrypted. So,

8	4	2	1
0	**1**	**0**	**1**

means each bit in the 12-bit register is shifted 5 places to the left and the register now becomes:

2048	1024	512	256	128	64	32	16	8	4	2	1
0	0	**1**	**0**	**0**	**1**	**1**	0	0	0	0	0

Therefore, the letter "S" would be transmitted with the 4-bit register and the 12-bit register as
follows:

0	1	0	1	0	0	1	0	0	1	1	0	0	0	0	0

(a) "W" is the 23rd letter of the alphabet.
(i) Show how this letter would be stored in the 12-bit register before encryption:

(ii) The 4-bit register contains the following value:

8	4	2	1
0	**1**	**1**	**0**

Show how the letter **"W"** is now stored in the 12-bit register in encrypted form:

[2]

+923002724734 /inqilabpatel inqilab patel
@inqilab inqilab-patel ruknuddin.com

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(b) Find which letter of the alphabet has been encrypted here. (Show all your working.)

0	0	1	1	0	0	0	0	1	1	0	0	1	0	0	0

.....

.....

.....

..... [2]

(c) **(i)** What is the largest encryption key that can be stored in the 4-bit register?

8	4	2	1

(ii) Convert this into denary (base 10).

.....

(iii) If this encryption key were used, what problem would it cause?

.....

..... [3]

Winter 2010

Q3) (a) What is meant by a virus?

.....

.....

.....

..... [2]

(b) What is meant by encryption?

.....

.....

..... [2]

(c) (i) A student wrote “I would make backup copies of my data to guard against viruses”. Why is the student’s statement not necessarily true?

.....

..... [2]

(ii) The same student also wrote “Encryption would stop a hacker accessing the data in my computer files”.
Why is the student’s statement incorrect?

.....

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..... [2]

Summer 2010

Q4) A company has set up an Internet website to sell their electrical goods online.

(a) Give two features you would expect to see on the website.

.....

..... [2]

(b) Payments for goods can be made by credit/debit cards. Data from the cards is encrypted.

(i) What is encryption?

(ii) Why is data encrypted?

.....

..... [2]

(c) Apart from credit card fraud, people have other fears about buying from the Internet. Describe one of these fears.

.....

..... [2]

Q5) The student is interested in how simple encryption could be applied to a text message. One of the simplest forms of encryption is a method of 'substitution' where each character has a unique substitute character.

The student uses this method with the following character substitutions:

Message character	A	B	C	D	E	F	G	H	I	J	K	L	M
Substitute character	P	L	F	N	O	C	Q	U	D	Z	V	G	I

Message character	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Substitute character	X	M	W	J	B	K	E	A	H	S	Y	R	T

Assume all messages are made up from the upper-case characters only.

Show the string after the message ATSEVEN is encrypted. .....

.....

..... [2]

Q6) The encryption of data is widely used in computing.

(a) One application is online banking.

State two other applications where encryption is used.

Describe the reason for encrypting the data for each application.

Application 1.....

Reason.....

Application 2.....

Reason ..... [4]

(b) Explain the terms plain text and cipher text.

Plain text .....

Cipher text .....[2]

(c) Symmetric encryption uses a single key.

Explain how a message is encrypted and decrypted using symmetric encryption.

.....
.....
..... [3]

(d) Authorisation and authentication are processes designed to protect the computer system and data.

Give one technique used for each.

Authorisation .....

Authentication ..... [2]

Q6) Winter 12, Winter 11, Summer 11, Winter 10, Summer 08, Winter 07

1 Give three features of a data protection act.

1. …….
2. …….
3. ……[3]

Winter 2014 P13

1 Give, with reasons, **three** safety issues associated with the use of computers in the office.

1. …….
2. …….
3. ……[3]

Safety issues e.g.:

– electrocution from bare wires or spilling liquids on live equipment

– trip hazard due to trailing wires

– risk of heavy equipment falling from inadequate desks

– risk of fire if insufficient equipment ventilation or overloaded wall sockets [3]

Computer Ethics

Ethics is a set of moral principles that govern the behaviour of a group or individual. Therefore, computer ethics is set of moral principles that regulate the use of computers. Some common issues of computer ethics include intellectual property rights (such as copyrighted electronic content), privacy concerns, and how computers affect society.

For example, while it is easy to duplicate copyrighted electronic (or digital) content, computer ethics would suggest that it is wrong to do so without the author's approval. And while it may be possible to access someone's personal information on a computer system, computer ethics would advise that such an action is unethical.

As technology advances, computers continue to have a greater impact on society. Therefore, computer ethics promotes the discussion of how much influence computers should have in areas such as artificial intelligence and human communication. As the world of computers evolves, computer ethics continues to create ethical standards that address new issues raised by new technologies.

Ten Commandments of Computer Ethics

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This short code of ethics for using computers and information technology is the best-known product of Computer Ethics Institute. It is often quoted in college-level textbooks and adopted for practical use. The biblical reference in the title does not imply any religious affiliation: it merely summarizes the importance of the rules compiled.

The Ten Commandments of Computer Ethics

1. Thou shalt not use a computer to harm other people.
2. Thou shalt not interfere with other people's computer work.
3. Thou shalt not snoop around in other people's computer files.
4. Thou shalt not use a computer to steal.
5. Thou shalt not use a computer to bear false witness.
6. Thou shalt not copy or use proprietary software for which you have not paid.
7. Thou shalt not use other people's computer resources without authorization or proper compensation.
8. Thou shalt not appropriate other people's intellectual output.
9. Thou shalt think about the social consequences of the program you are writing or the system you are designing.
10. Thou shalt always use a computer in ways that ensure consideration and respect for your fellow humans.

Ethical Issues of Computer:

There are different ethical issues raised by the spread of electronic communication and computer systems. These include:

- Copyright infringement
- Plagiarism
- Hacking
- Cracking
- Production of malware

Copyright is a legal concept, enacted by most governments, that grants the creator of an original work exclusive rights to its use and distribution, usually for a limited time, with the intention of enabling the creator of intellectual wealth (e.g. the photographer of a photograph or the author of a book) to receive compensation for their work and be able to financially support themselves.

Copyright is a form of intellectual property (as patents, trademarks and trade secrets are), applicable to any expressible form of an idea or information that is substantive and discrete.

Copyright Issues

Very briefly, copyright gives the author of a work the right...

- ...to reproduce the work.
- ...to permit copies to be made by others.
- ...to prepare derivative works.
- ...to display the copyrighted work publicly.

Plagiarism is the practice of taking someone else's work or ideas and passing them off

as one's own.

"Plagiarism is the deliberate or reckless representation of another's words, thoughts, or ideas as one's own without attribution in connection with submission of academic work, whether graded or otherwise."

Plagiarism is considered academic dishonesty and a breach of Computer ethics. It is subject to sanctions like expulsion.

Plagiarism is not a crime *per se* but in academia and industry it is a serious ethical offense, and cases of plagiarism can constitute copyright infringement.

Hacking

Hacking means gaining unauthorised access to a computer, locally or over a network. Hacking can be prevented by installing firewall, requiring a valid username and password to gain access to the computer.

Use passwords that are long enough and are changed regularly.

Use encryption with sensitive data (e.g. credit card details).

Cracking

Software cracking is the modification of software to remove or disable features which are considered undesirable by the person cracking the software, usually related to break license.

Production of Malware

Malware (malicious software) is specifically designed to disrupt or damage a computer system, such as a virus.

Malware, short for **malicious software**, is software used to disrupt computer operation, gather sensitive information, or gain access to private computer systems. It can appear in the form of code, scripts, active content, and other software. 'Malware' is a general term used to refer to a variety of forms of hostile or intrusive software.

C***omputer virus*** is a program that has infected some executable software and, *when run*, causes the virus to spread to other executables.

A ***worm*** is a program that *actively* transmits itself over a network to infect other computers.

A **Trojan** horse is any program that invites the user to run it, concealing harmful or malicious code.

Once a malicious program is installed on a system, it is essential that it stays concealed, to avoid detection. Software packages known as *root kits* allow this concealment, by modifying the host's operating system so that the malware is hidden from the user.

A backdoor is a method of bypassing normal authentication procedures. Once a system has been compromised, one or more backdoors may be installed in order to allow easier access in the future. Backdoors may also be installed prior to malicious software, to allow attackers entry.

Freeware is copyrighted computer software which is made available for use free of charge, for an unlimited time. Authors of freeware often want to "give something to the community", but also want to retain control of any future development of the software.

The term **shareware** refers to commercial software that is copyrighted, but which may be copied for others for the purpose of their trying it out with the understanding that they will pay for it if they continue to use it.

Free software is computer software that is distributed along with its source code, and is released under terms that guarantee users the freedom to study, adapt/modify, and distribute the software.

1. **A What is meant by 'software copyright'?**

Soft ware copyright guarantees that the author or developer of the work is the person legally entitled to get commercial benefit from it.

b Name three activities which would break software copyright.

- giving a copy to a friend
- making a copy and then selling it
- using the software on a network (unless the licence allows it)
- renting the software without the permission of the copyright holder

2. What is meant by Plagiarism?

Plagiarism *is the "wrongful appropriation" and "purloining and publication" of another author's "language, thoughts, ideas, or expressions," and the representation of them as one's own original work.*

Plagiarism is considered academic dishonesty and a breach of journalistic ethics. It is subject to sanctions like expulsion.

3. Distinguish between Free Software, Freeware, Shareware

Free software is computer software that is distributed along with its source code, and is released under terms that guarantee users the freedom to study, adapt/modify, and distribute the software.

Freeware is copyrighted computer software which is made available for use free of charge, for an unlimited time. Authors of freeware often want to "give something to the community", but also want to retain control of any future development of the software.

The term **shareware** refers to commercial software that is copyrighted, but which may be copied for others for the purpose of their trying it out with the understanding that they will pay for it if they continue to use it.

4. **Define the term 'hacking' and how can it be prevented?**

Hacking means gaining unauthorised access to a computer, locally or over a network. Hacking can be prevented by installing firewall, requiring a valid username and password to gain access to the computer.

Use passwords that are long enough and are changed regularly.

Use encryption with sensitive data (e.g. credit card details).

5. Describe the term cracking.

Software cracking is the modification of software to remove or disable features which are considered undesirable by the person cracking the software, usually related to break license.

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6. **a Define the term 'Malware' and describe different types of malware.**
   Malware, short for **malicious software**, is software used to disrupt computer operation, gather sensitive information, or gain access to private computer systems, such as virus, worm and Trojans.

   b What is a virus? And describe two effects of virus.
   A computer virus is a piece of program code within a data or program file that copies itself and 'infects' other files in the computer.
   Virus may corrupt Data and programs

   c How can a computer be protected against a virus?
   - Using up to date anti-virus software.
   - Not opening an email attachment unless you are expecting it and know the source (many email servers scan emails with anti-virus software on the user's behalf).
   - Not allowing other users to use their own memory stick on your system.
   - Only downloading files from reputable web sites.
   - Avoiding software from unreliable sources.

   d Why does making backup copies of data cannot guard against the effects of viruses?

7. **Why is it important to secure data on a computer system?**
   It is important to secure data on a computer system to reduce the risk of corruption and/or loss and to make sure it is only accessed by authorised users.
8. **What can be done to prevent the theft of data?**
   The theft of data can be prevented by requiring a valid user name and password to gain access to a computer.
9. **Give four features of Data Protection Act.**

The principles on which data protection legislation is based are:
• Personal data may only be obtained and processed fairly, lawfully and for specified purposes.
• Data must be accurate, kept up-to-date, sufficient, relevant, and not excessive and deleted when no longer needed.
• Individuals have a right of access to the data held about them and to have factually incorrect information corrected.
• Data must be protected from corruption, loss and access by or disclosure to people who are not authorised to see them.
• Data must not be transferred to another country unless that country provides a similar level of legal protection for personal data.

10. **Data corruption sometime occurs in computer system.**
    Give two ways that corruption could occur and for each suggest how data may be protected.
    Data may be corrupted due to sudden power breakdown, Use UPS to prevent it
    Data may be corrupt due to malfunction in hard disk. Use backup files.

11. A company is concerned about three aspects of the security of data stored in computer files:

• data corruption • data loss • illegal access to data

For each of the above, give one reason why it could occur and state one method of prevention. Your reasons must be different in each case.

Any three different reasons and associated preventions
(prevention must match reason):
1 mark for reason, 1 mark for prevention
award each point only once
data corruption and data loss
viruses -use antivirus software, firewalls, no Internet access
power loss – back-ups, UPS
malicious damage – back-ups, password protection, controlled access
computer crash – back-ups, parallel computer (systems)
damage to CDs/disks – back-ups
operator error – training / good user interfaces
illegal access
hacking/unauthorised access – passwords, log-in ids, anti-hacking software
(physical) lock room/computer
computer left logged on – log off when not in use, lock computer

12. **A bank is worried about computer crime. One of their concerns is online access to** customer accounts.

(a) How can a customer's access details be discovered by criminals?
(b) Why would a customer using a credit card for online shopping be more of a security risk than a customer using the same card in a shop?
(c) Describe what measures the bank can take to safeguard customer accounts.

(a) 1 mark each for 2 concerns
OR 1 mark for concern + 1 mark for expansion:
– customer goes online in a public place …..
…… and is overlooked as they enter id/password/PIN
– customer receives emails taking them to a false site …..
….. where they are asked to confirm details by entering them
– customer downloads virus, spyware, …..
….. which logs all key presses including id/password/PIN [2]
(b) Any two points from:
– don't need card number for online transaction/card number already
– online user is anonymous/not visible
– online the customer does not need the card and signature/PIN [2]
(c) Any two points from:
– secure sites using encryption
– use of passwords/PINs/biometrics/advice to change PIN regularly
– no communications with customer requiring personal details
– use of home card readers that generate codes known only to bank and customer
– check with customer at each log on when they were last logged on to the website

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– contact customer if unusual transaction/random check
– customer asked to inform bank if intending to use card in another country
– customer asked to inform bank if card lost/stolen
– ensure firewall is in place

May/June 2006

10 Many bank customers now bank on-line using the Internet.
(a) State two advantages for the bank of on-line banking.

……
…… [2]

(b) State two disadvantages for a bank customer of on-line banking.

……
…… [2]

(c) State three data protection rules that could apply to the customer data stored on a bank computer system.

……
……
…… [3]

12 A music club keeps its members' details on a computer file.
(a) Complete the table below which shows the data type, field length and validation check used for the club members' data.

	Data type	Field length	Validation check
Name			
Address			
Date of birth			
E-mail address			

Oct/Nov 2006

1 Explain, using examples where appropriate, the following computer terms:
(a) verification

……
…… [2]

3 (a) Give two examples of computer crime.

……
…… [2]

(b) Describe two methods used to prevent computer crime.

……
…… [2]

4 State three effects on society due to the increase of businesses using e-commerce.

……
……
……
…… [3]

May/June 2007

7 A hospital has decided to computerise its administration system.

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(a) Give three ways this could affect the hospital workers.
……
……
…… [3]
The hospital will be using a database which holds confidential personal data.
(b) State two precautions that the hospital should take to prevent unauthorised access to the data.
……
…… [2]
(c) Describe how the database could be recovered if it became corrupted.
……
…… [2]
(d) Give one example, in each case, of when it would be necessary to amend data, delete data and insert data into the patient database.
……
……
…… [3]

Input data needs to go through a validation process.
(i) Explain the term validation.
……
……
(ii) Describe one type of validation check.
……
……

Oct/Nov 2007
4 Online banking using the Internet is now increasing.
(a) Give one advantage to the customer of using online banking.
……
…… [1]
(b) Give one advantage to the bank of providing online banking.
……
…… [1]
(c) Online banking has an impact on society as a whole.
(i) Give one positive effect.
……
……
(ii) Give one negative effect.
……
…… [2]
(d) Describe two concerns people might have regarding online banking
……
…… [2]
5 (a) (i) Name one method used to protect data against unauthorised access.
……
…… [1]
(ii) Name one method used to protect data in a file from being understood when an unauthorised person has gained access to the file.
……

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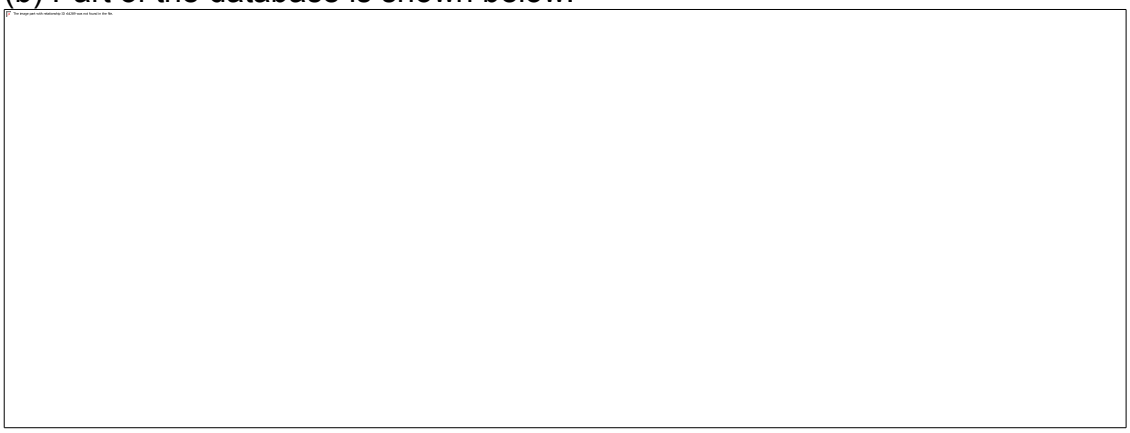
…… [1]

A school Science department is going to use a database to record details about its equipment.

(b) Part of the database is shown below:



(i) As data is entered it needs to be verified. Describe one way this could be done.[1]

……
……

(ii) Data also needs to be validated. Using fields from the database as examples,Describetwodifferent validation checks which could be performed on the data.

……
……

May/June 2008

5 Computer systems can be affected by viruses.

(a) What is a virus?

……
…… [1]

(b) Give one effect of a virus.

……
…… [1]

(c) How can a system be protected from viruses?

……
…… [1]

(d) Why would backing up data not guard against the effect of a virus?

……
……

Students' records are kept on a stand-alone computer (no network connections) in the principal's office.

(c) Students are concerned that their personal data could be misused. Name two methods that could be used to ensure personal data is kept secure.

……
…… [2]

(d) Examination results are stored in students' records as marks out of 100. Give two different validation checks that could be performed on students' marks.

……
……
…… [2]

6 Students' records are kept on a stand-alone computer (no network connections) in the

Computer Science with Inqilab Patel

principal's office.
(a) It is sometimes necessary to alter students' records. To do this efficiently, individual records need to be retrieved quickly.
(i) What type of file access should be used?
……
…… [1]
(ii) What type of magnetic medium allows this type of access?
……
…… [1]
(b) Give two examples of when a student's record would need to be altered.
……
…… [2]
(c) Students are concerned that their personal data could be misused. Name two methods that could be used to ensure personal data is kept secure.
……
…… [2]
(d) Examination results are stored in students' records as marks out of 100. Give two different validation checks that could be performed on students' marks.
……
…… [2]

Oct/Nov 2008

4 Computer systems can be affected in various ways which could lead to data corruption.
Give two ways that data might be corrupted and suggest a method of protection for each.
……
……
……
…… [4]

7 Many people now bank through the Internet rather than using banks located in towns.
(a) Give one advantage to a bank that offers Internet banking.
……
…… [1]
(b) Give one disadvantage to a bank that offers Internet banking.
……
…… [1]
(c) Give two advantages to customers of using Internet banking.
……
…… [2]
(d) Give two disadvantages to customers of using Internet banking.
……
…… [2]

8 To gain access to a database, a user must first type in a user ID and then a password which needs to be verified.
(a) How is a password usually verified?
……

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…… [1]

(b) In spite of these safeguards, unauthorised access to the database is still possible. What could be done:

(i) to prevent data being used by unauthorised people?

……
…… [1]

(ii) to prevent loss of data once the database has been illegally accessed?

……
…… [1]

(c) Personal data is protected to some extent by a Data Protection Act. Give two requirements of a Data Protection Act.

……
…… [2]

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Winter 2014 P12

Six statements and six values are shown below.
Each statement will generate one possible value.
Draw a line to link each statement to its correct value.

statement	value
number of times the following loop operates: count = 1 **repeat** **input** x count = count + 1 **until** count = 5	1
the number of bits that make up a byte	4
base 10 (denary) value of the following binary number: 32 16 8 4 2 1 0 0 1 1 1 1	5
the number of tracks on the single side of a CD-R	8
number of minutes to upload a 75 Mbyte file at 2 megabits/ second upload speed	10
If there are 2^X bytes in a Kbyte, what is the value of **X**?	15

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Winter 2014 P13

Six statements and six values are shown below.
Each statement will generate one possible value.
Draw a line to link each statement to its correct value.

statement	value
number of possible binary input combinations for a 2-input logic gate circuit	0
output from the logic gate:	1
base 10 (denary) value of the following binary number: 4 2 1 1 1 0	4
what is the output from the algorithm: y = 1 **for** x = 1 **to** 4 y = y * x **next** x **print** y	6
number of bytes formed from 8 bits	20
If there are 2^x bytes in a Mbyte, what is the value of **X**?	24

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Past Papers

PATEL

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Summer 2015 P11

1 (a) State what is meant by the terms:

Parallel data transmission: ....
.....
.....

Serial data transmission: .....
.....
..... [2]

(b) Give **one** benefit of each type of data transmission.

Parallel data transmission

Benefit: .....
.....

Serial data transmission

Benefit: .....
..... [2]

(c) Give **one** application of each type of data transmission. Each application must be different.

Parallel data transmission

Application: .....
.....

Serial data transmission

Application: .....
..... [2]

2 (a) State what is meant by the term USB.

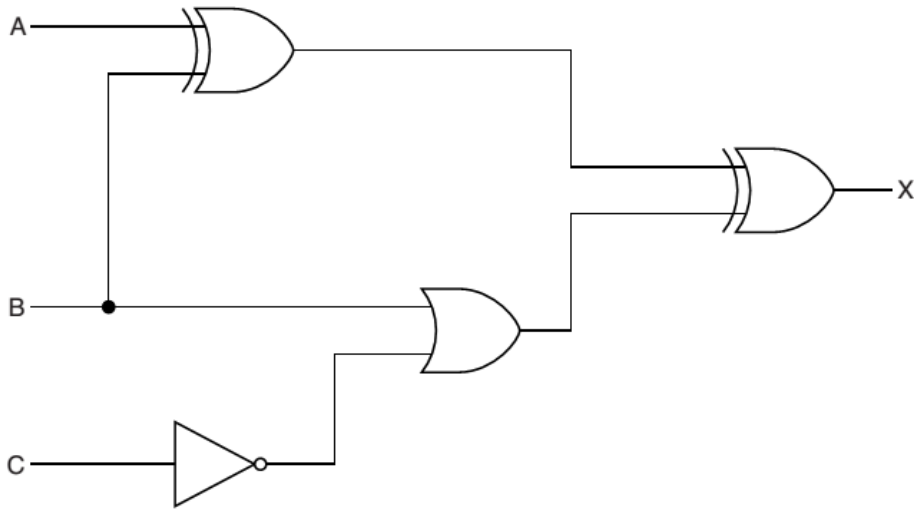
.....
..... [1]

(b) Describe **two** benefits of using USB connections between a computer and a device.

1: .....
.....
.....

2: .....
.....
..... [2]

3 (a) Complete the truth table for the following logic circuit:



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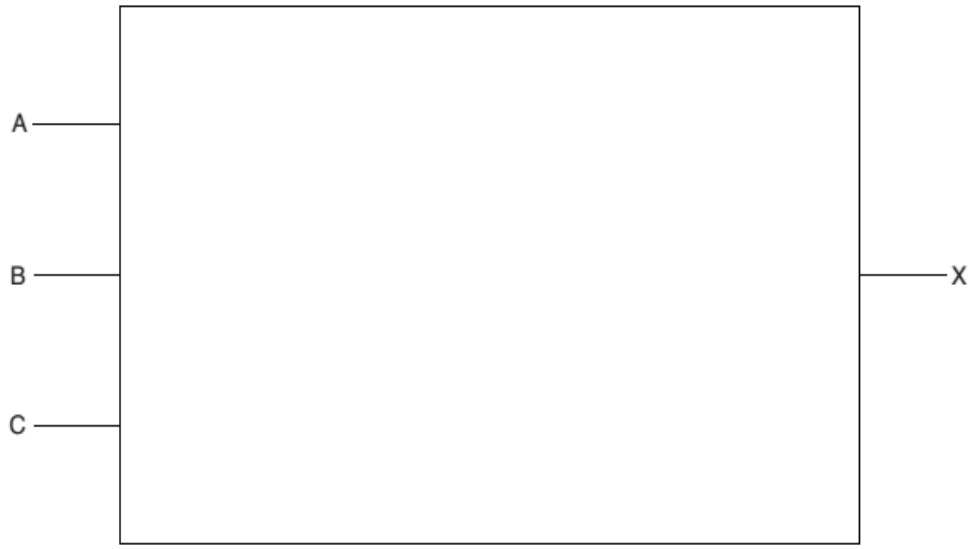
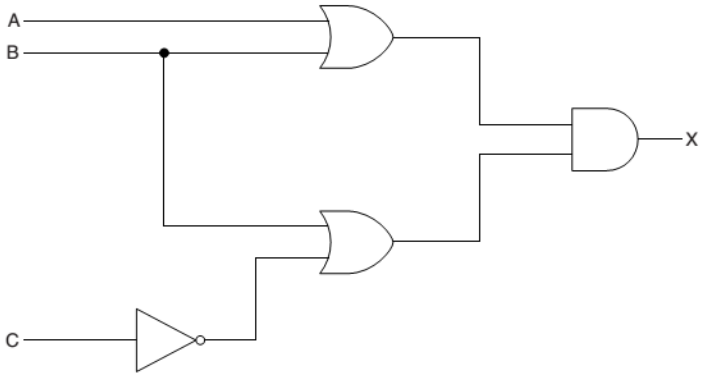
A	B	C	Workspace	X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

(b) Draw a logic circuit which corresponds to the following logic statement:
X = 1 if ((A is **NOT** 1 **OR** B is 1) **AND** C is 1) **OR** (B is **NOT** 1 **AND** C is 1)



[3]

(c) Write a logic statement which corresponds to the following logic circuit:



.....
.....
.....[3]

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Computer Science with Inqilab Patel

4 Choose **six** correct terms from the following list to complete the spaces in the paragraphs below:

- encryption
- file name
- firewall
- HTML tags/text
- IP address
- protocol
- proxy server
- SSL certificate
- web server name

A user enters a URL. The web browser breaks up the URL into **three** components:
1 .....
2 .....
3 .....
The web server returns the selected web page.
The web browser reads the ..... from the selected page and shows the correctly formatted page on the user's screen.
A ..... is used between the user's computer and the network to examine the data traffic to make sure it meets certain criteria.
To speed up the access to the web pages next time, a ..... is used between the computer and web server; this device uses a cache to store the website home page after it has been accessed for the first time. [6]

5 Five storage devices are described in the table below.
In column 2, name the storage device being described.
In columns 3, 4, or 5, tick (✓) to show the appropriate category of storage.

1	2	3	4	5
Description of storage device	Name of storage device	Category of storage		
		Primary	Secondary	Off-line
optical media which use one spiral track; red lasers are used to read and write data on the media surface; makes use of dual-layering technology to increase the storage capacity				
non-volatile memory chip; contents of the chip cannot be altered; it is often used to store the start up routines in a computer (e.g. the BIOS)				
optical media which use concentric tracks to store the data; this allows read and write operations to be carried out at the same time				
non-volatile memory device which uses NAND flash memories (which consist of millions of transistors wired in series on single circuit boards)				
optical media which use blue laser technology to read and write data on the media surface; it uses a single 1.1 mm polycarbonate disc				

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6 (a) Viruses, pharming and phishing are all examples of potential Internet security issues. Explain what is meant by each of these **three** terms.

Virus: .....
.....
Pharming: .....
.....
.....
Phishing: .....
.....
.....[6]

(b) An online bank requires a client to supply an 8-digit code each time they wish to access their account on the bank's website.

Rather than ask the client to use a keyboard, they are requested to use an on-screen keypad (shown on the right) to input the 8-digit code.

The position of the digits on the keypad can change each time the website is visited.

The client uses a mouse or touch screen to select each of the8 digits.

2	**5**	**1**
6	**8**	**3**
9	**0**	**4**
	7	

(i) Explain why the bank has chosen to use this method of entering the 8 digits.

.....
.....
.....
.....
..... [2]

(ii) Name and describe **another** measure that the bank could introduce to improve the security of their website.

Name: .....
Description: .....
.....
.....
..... [2]

7 (a) One of the key features of von Neumann computer architecture is the use of buses.

Three buses and three descriptions are shown below.

Draw a line to connect each bus to its correct description.

Address bus	this bus carries signals used to coordinate the computer's activities
Control bus	this bi-directional bus is used to exchange data between processor, memory and input/ output devices
Data bus	this uni-directional bus carries signals relating to memory addresses between processor and memory

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(b) The seven stages in a von Neumann fetch-execute cycle are shown in the table below. Put each stage in the correct sequence by writing the numbers 1 to 7 in the right hand column. The first one has been done for you.

Stage	Sequence number
the instruction is then copied from the memory location contained in the MAR (memory address register) and is placed in the MDR (memory data register)	
the instruction is finally decoded and is then executed	
the PC (program counter) contains the address of the next instruction to be fetched	1
the entire instruction is then copied from the MDR (memory data register) and placed in the CIR (current instruction register)	
the address contained in the PC (program counter) is copied to the MAR (memory address register) via the address bus	
the address part of the instruction, if any, is placed in the MAR (memory address register)	
the value in the PC (program counter) is then incremented so that it points to the next instruction to be fetched	

8 An alarm clock is controlled by a microprocessor. It uses the 24 hour clock. The hour is represented by an 8-bit register, **A**, and the number of minutes is represented by another 8-bit register, **B**.

(a) Identify what time is represented by the following two 8-bit registers.

A

128	64	32	16	8	4	2	1
0	0	0	1	0	0	1	0

:

B

128	64	32	16	8	4	2	1
0	0	1	1	0	1	0	1

Hours ..... Minutes ..... [2]

(b) An alarm has been set for 07:30. Two 8-bit registers, **C** and **D**, are used to represent the hours and minutes of the alarm time.

Show how 07:30 would be represented by these two registers:

C

:

D

Hours Minutes [2]

(c) Describe how the microprocessor can determine when to sound the clock alarm.

.....

.....

.....

.....

.....

..... [3]

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(d) The LCD (liquid crystal display) on the clock face is back-lit using blue LEDs (light emitting diodes). The brightness of the clock face is determined by the level of light in the room. The amount of light given out by the LEDs is controlled by a control circuit.
Describe how the sensor, microprocessor and LEDs are used to maintain the correct brightness of the clock face.

.....
.....
.....
.....
.....
.....
.....
..... [3]

(e) Modern LCD monitors and televisions use LED back-lit technology.
Give **two** advantages of using this new technology compared to the older cold cathode fluorescent lamp (CCFL) method.

1 .....
.....
.....

2 .....
.....
..... [2]

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9 Draw a line to connect each question to the correct answer. [5]

Question	Answer
What is the denary (base 10) equivalent to the hexadecimal digit **E**?	**8**
If 1 GB = 2^x then what is the value of X?	**12**
How many bits are there in one byte?	**14**
If the broadband data download rate is 40 megabits per second, how many seconds will it take to download a 60 MB file?	**19**
What is the denary (base 10) value of the binary number 0 0 1 0 0 1 0 0 ?	**30**
What hexadecimal value is obtained when the two hexadecimal digits **C** and **D** are added together?	**36**

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10 Five statements about interpreters and compilers are shown in the table below.
Study each statement.
Tick (✓) to show whether the statement refers to an interpreter or to a compiler. [5]

Statement	**Interpreter**	**Compiler**
takes one statement at a time and executes it		
generates an error report at the end of translation of the whole program		
stops the translation process as soon as the first error is encountered		
slow speed of execution of program loops		
translates the entire program in one go		

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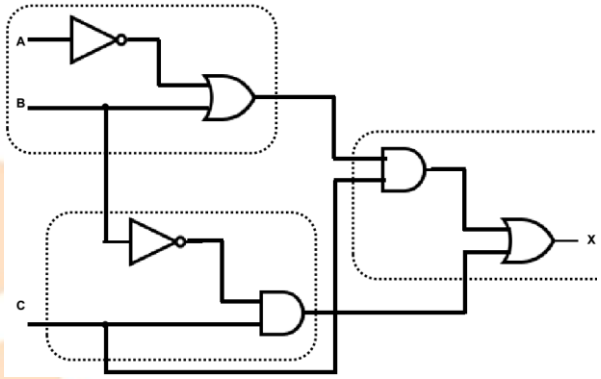
Marking scheme

Q1) (a) parallel
any one from:
– 8 bits/1 byte/multiple bits sent at a time
– using many/multiple/8 wires/lines (1 mark)
serial
any one from:
– one bit sent at a time
– over a single wire (1 mark) [2]
(b) parallel
– faster rate of data transmission (1 mark)
serial
any one from:
– more accurate/fewer errors over a longer distance
– less expensive wiring
– less chance of data being skewed/out of synchronisation/order (1 mark)
(c) parallel
any one from:
– sending data from a computer to a printer
– internal data transfer (buses) (1 mark)
serial
– connect computer to a modem (1 mark)
2 (a) – universal serial bus
– description of USB [1]
(b) Any two from:
– devices are automatically detected and configured when initially attached
– impossible to connect device incorrectly/connector only fits one way
– has become the industry standard
– supports multiple data transmission speeds
– lots of support base for USB software developers
– supported by many operating systems
– backward compatible
– faster transmission compared to wireless [2]

A	B	C	Working	X
0	*0*	*0*		*1*
0	*0*	*1*		*0*
0	*1*	*0*		*0*
0	*1*	*1*		*0*
1	*0*	*0*		*0*
1	*0*	*1*		*1*
1	*1*	*0*		1
1	*1*	1		1

(b)



(c) X is 1 if:
(A is 1 OR B is 1) (1 mark)
AND (1 mark)
(B is 1 OR C is NOT 1) (1 mark)
accept equivalent ways of writing this:
e.g. (A OR B = 1) AND (B OR NOT C = 1)
e.g. (A OR B) AND (B OR NOT C)
e.g. (A + B) (B + C) [3]
Q4) 1 mark per correct word
1 protocol
2 web server name accept these three items in any order
3 file name
HTML tags/text
firewall
proxy server
Q5)
1 mark per device, 1 mark per category

1	2	3	4	5
Description of storage device	Name of storage device	Category of storage		
		Primary	Secondary	Off-line
optical media which use one	DVD			✓

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spiral track; red lasers are used to read and write data on the media surface; makes use of dual-layering technology to increase the storage capacity				
non-volatile memory chip; contents of the chip cannot be altered; it is often used to store the start up routines in a computer (e.g. the BIOS)	ROM			
optical media which use concentric tracks to store the data; this allows read and write operations to be carried out at the same time	DVD-RAM			✓
non-volatile memory device which uses NAND flash memories (which consist of millions of transistors wired in series on single circuit boards)	Solid state Drive SSD		✓	
optical media which use blue laser technology to read and write data on the media surface; it uses a single 1.1 mm polycarbonate disc	Blu-ray			✓

6 (a) virus
any two from:
– program/software that replicates/copies itself
– can delete or alter files/data stored on a computer
– can make the computer "crash"/run slow
pharming
any two from:
– malicious code/software installed on a user's hard drive/actual web server
– this code redirects user to a fake website (without their knowledge)
– to obtain personal/financial information/data
phishing
any two from:
– legitimate-looking emails sent to a user
– as soon as recipient opens/clicks on link in the email/attachment …
– … the user is directed to a fake website (without their knowledge)
– To obtain personal/financial information/data
(b) (i) Any two from:
– spyware/key logging software can only pick up key presses
– using mouse/touch screen means no key presses to log
– the numbers on the key pad are in random/non-standard format, which makes it more difficult to interpret [2]
(ii) 1 mark for name and 1 mark for description
any one from:
chip and PIN reader
– only the user and the bank know which codes can be generated
request user name
– additional security together with password/PIN
anti-virus
– removes/warns of a potential virus threat which can't be passed on to customers
firewall
– (helps) to protect bank computers from virus threats and hacking
encryption
– protects customer data by making any hacked information unreadable
security protocol
– governs the secure transmission of data
Biometric
– to recognise user through the use of, e.g. facial/retina/finger print
Alerts
– users IP/MAC address is registered and user is alerted through, e.g. SMS if account is accessed through an unregistered address

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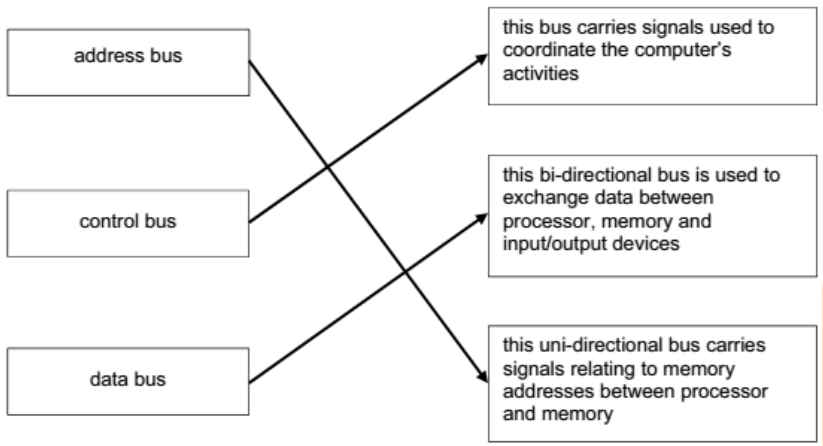
7 (a)



Stage	Sequence number
the instruction is then copied from the memory location contained in the MAR (memory address register) and is placed in the MDR (memory data register)	3
the instruction is finally decoded and is then executed	7
the PC (program counter) contains the address of the next instruction to be fetched	1
the entire instruction is then copied from the MDR (memory data register) and placed in the CIR (current instruction register)	4
the address contained in the PC (program counter) is copied to the MAR (memory address register) via the address bus	2
the address part of the instruction, if any, is placed in the MAR (memory address register)	6
the value in the PC (program counter) is then incremented so that it points to the next instruction to be fetched	5

The incrementation of the program counter can appear at any stage after 2. All other stages must be in the correct given order. [6]

8 (a) hours: 18
minutes: 53 [2]
(b)

hours ("C")									minutes ("D")							
0	0	0	0	0	1	1	1	:	0	0	0	1	1	1	1	0

(c) Any three from:
– reads values in registers "C" and "D"
– and checks the values against those stored in registers "A" and "B"
(NOTE: the first two statements can be interchanged, i.e. "A" and "B" read first)
– If values in corresponding registers are the same
– the microprocessor sends a signal to sound alarm/ring [3]
(d) Any three from:
– uses a light sensor
– sends signal/data back to microprocessor
– signal/data converted to digital (using ADC)
– value compared by microprocessor with pre-set/stored value
– if value < stored value, signal sent by microprocessor …
– … to the voltage supply (unit)
– … "value" of signal determines voltage supplied/brightness of LED [3]
(e) Any two from:
– no need to warm up
– whiter tint/more vivid colours/brighter image
– higher resolution
– much thinner monitors possible/lighter weight
– more reliable technology/longer lasting
– uses much less power/more efficient [2]

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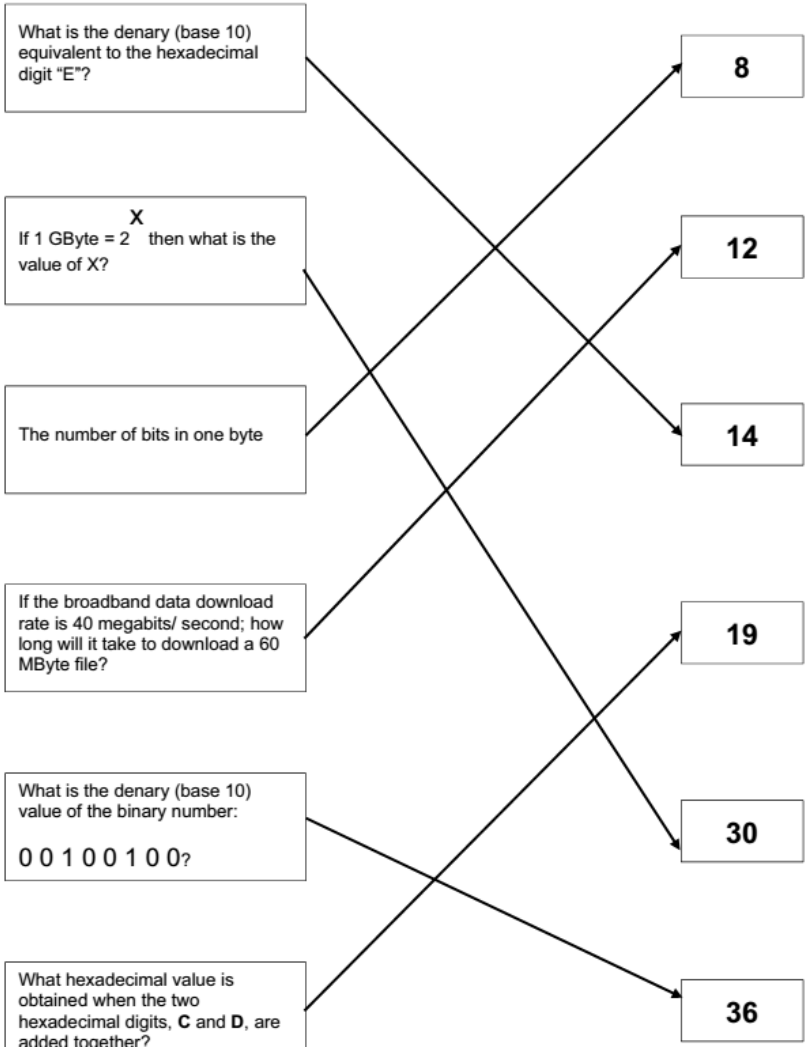
9



Q 10)

Statement	Interpreter	Compiler
takes one statement at a time and executes it	✓	
generates an error report at the end of		✓
translation of the whole program		
stops the translation process as soon as the first error is encountered	✓	
slow speed of execution of program loops	✓	
translates the entire program in one go		✓

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Summer 2015 P12

1 (a) Four statements about cookies are shown in the table below.

Study each statement.

Tick (✓) to show whether the statement is true or false.

Statement	True	False
they are a form of spyware		
they are used only in advertising		
they are used to track browser use		
they act in the same way as a virus		

(b) Five descriptions and five security issues are shown below.

Draw a line to connect each description to the correct security issue.

Description	Security issue
malicious code installed on the hard drive of a user's computer or on the web server; this code will re-direct user to a fake web site without their consent	hacking
software that gathers information by monitoring key presses on a user's computer and relays the information back to the person who sent the software	pharming
program or code that replicates itself and is designed to amend, delete or copy data and files on a user's computer without their consent	phishing
the act of gaining illegal access to a computer system without the owner's consent	spyware
creator of code sends out a legitimate-looking email in the hope of gathering personal and financial data; it requires the recipient to follow a link in the email or open an attachment	virus

2 The majority of mobile phones use touch screens. Three common technologies are used by different mobile phone manufacturers.

Choose one of the following mobile phone technologies:

• resistive • capacitive • infrared

Chosen technology .....

(i) Describe how your chosen technology works to allow a user to make selections by touching the screen.

.....

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.....
.....
.....
.....[2]

(ii) Give **one** benefit and **one** drawback of your chosen technology when used on mobile phone touch screens.

Benefit

.....
.....

Drawback

.....
..... [2]

3 Four input devices, four descriptions and four applications are shown below.
Draw a line to connect each input device to its correct description. Then connect each description to its correct application. [6]

Input device	Description	Application
barcode reader	copies paper documents and converts the text and pictures into a computer-readable form	voice recognition
microphone	reads labels containing parallel dark and light lines using laser light or LEDs; the width of each line represents a binary code	reading passports
pH sensor	detects changes in acidity levels; data is often in analogue form	automatic stock control
scanner	device that allows audio signals to be converted into electric signals; these can be interpreted by a computer after being converted into digital form	monitor soil in a greenhouse

4 (a) State what is meant by the term SSL.

.....
.....
.....[1]

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(b) The following stages take place when a user wishes to access a secure website.
Put each stage in sequence by writing the numbers 1 to 6 in the column on the right. The first one has been done for you. [5]

Stage	Sequence number
the encrypted data is then shared securely between the web browser and the web server	
the web browser attempts to connect to a website which is secured by SSL	**1**
the web server sends the web browser a copy of its SSL certificate	
the web browser requests the web server to identify itself	
the web server will then send back some form of acknowledgement to allow the SSL encrypted session to begin	
the web browser checks whether the SSL certificate is trustworthy; if it is, then the web browser sends a message back to the web server	

5 Parity checks are often used to check for errors that may occur during data transmission.
(a) A system uses **even parity**.
Tick (✓) to show whether the following three bytes have been transmitted correctly or incorrectly.

Received byte	Byte transmitted correctly	Byte transmitted incorrectly
1 1 0 0 1 0 0 0		
0 1 1 1 1 1 0 0		
0 1 1 0 1 0 0 1		

(b) A parity byte is used to identify which bit has been transmitted incorrectly in a block of data.
The word "F L O W C H A R T" was transmitted using nine bytes of data (one byte per character).
A tenth byte, the parity byte, was also transmitted.
The following block of data shows all ten bytes received after transmission. The system uses **even parity** and column 1 is the parity bit.

	letter	column 1	column 2	column 3	column 4	column 5	column 6	column 7	column 8
byte 1	F	1	0	1	0	0	1	1	0
byte 2	L	1	0	1	0	1	1	0	0
byte 3	O	1	0	1	0	1	1	1	1
byte 4	W	1	0	1	1	0	1	1	1
byte 5	C	1	0	1	0	0	0	1	1
byte 6	H	0	0	1	0	1	0	0	0
byte 7	A	0	0	1	0	0	1	0	1
byte 8	R	1	0	1	1	0	0	1	0
byte 9	T	1	0	1	1	0	1	0	0
parity byte		1	0	1	1	1	1	1	0

(i) One of the bits has been transmitted incorrectly.
Write the byte number and column number of this bit:
Byte number ..... Column number ..... [2]

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(ii) Explain how you arrived at your answer for **part (b)(i)**.

.....
.....
.....
.....[2]

(c) Give the denary (base 10) value of the byte: **1 0 1 1 1 1 0**

.....
.....[1]

(d) A parity check may not identify that a bit has been transmitted incorrectly.
Describe **one** situation in which this could occur.

.....
.....
.....[1]

6 A gas fire has a safety circuit made up of logic gates. It generates an alarm (X = 1) in response to certain conditions.

Input	Description	Binary value	Conditions
G	gas pressure	1	gas pressure is correct
		0	gas pressure is too high
C	carbon monoxide level	1	carbon monoxide level is correct
		0	carbon monoxide level is too high
L	gas leak detection	1	no gas leak is detected
		0	gas leak is detected

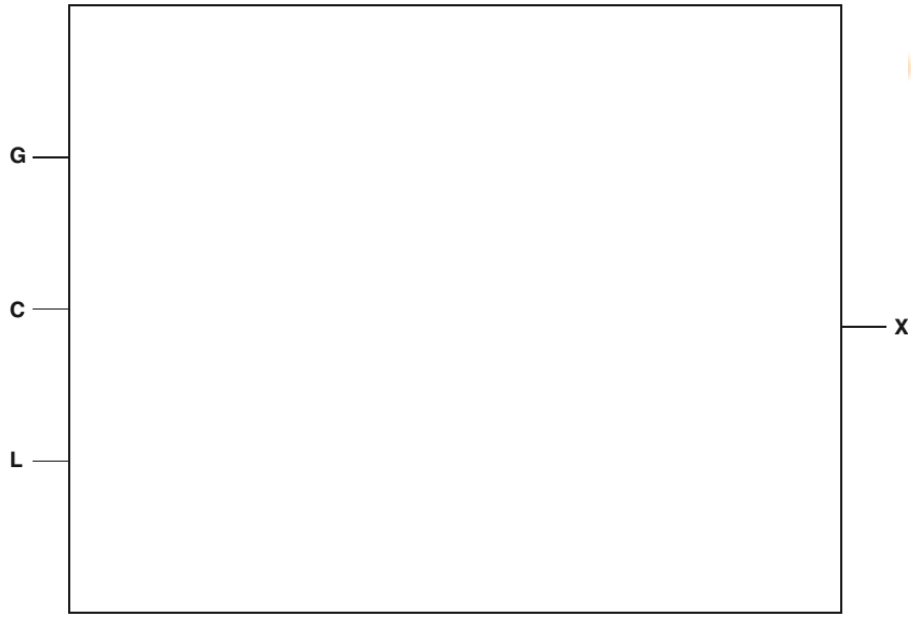
The output X = 1 is generated under the following conditions:

gas pressure is correct **AND** carbon monoxide level is too high

OR

carbon monoxide level is correct **AND** gas leak is detected

(a) Draw a logic circuit for this safety system. [5]



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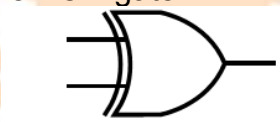
(b) Complete the truth table for the safety system. [4]

G	C	L	Workspace	X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

(c) Complete the truth table for the XOR gate:



A	B	C
0	0	
0	1	
1	0	
1	1	

7 (a) Street lighting is controlled automatically. A light sensor and a microprocessor are used to decide when to switch each street light on or off.
Describe how the sensor, microprocessor and light interact to switch the street light on or off. Include in your answer how the microprocessor stops the street lights being frequently switched on and off due to brief changes in the light intensity.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....[5]

(b) Name **three** different sensors (other than light and pH) and describe an application for each of these sensors.
A different application is needed for each sensor.
Sensor
1 .....

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Application .....
.....
Sensor 2 .....
Application .....
.....
Sensor 3 .....
Application .....
..... [6]

8 Five computing terms are described below.
Write the name of the term being described.

Software that anyone can download for free from the Internet and then use without having to pay any fees. The usual copyright laws apply and a user license is important.

.....

Software that gives the user the chance to try it out free of charge before actually buying it. The software is subject to the usual copyright laws. As a rule, not all the features found in the full version are available at this stage. .....

Software where users have freedom to run, copy, change and adapt it. This is an issue of liberty and not of price since the software guarantees freedom and the right to study and modify the software by having access to the actual source code. .....

Set of principles that regulates the use of computers in everyday life. This covers intellectual property rights, privacy issues and the effects of computers on society in general. .....

The taking of somebody's idea or software and claim that the idea or software code were created by the "taker". ..... [5]

9 (a) Five statements about interpreters and compilers are shown in the table below.
Study each statement.
Tick (✓) to show whether the statement refers to an interpreter or to a compiler.

Statement	**Interpreter**	**Compiler**
creates an executable file that runs directly on the computer		
more likely to crash the computer since the machine code produced runs directly on the processor		
easier to debug since each line of code is analysed and checked before being executed		
slow speed of execution of program loops		
it is more difficult to modify the executable code, since it is in machine code format		

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(b) State why a compiler or an interpreter is needed when running a high-level program on a computer.

.....
.....
..... [1]

(c) Give **one** benefit of writing a program in a high-level language.

.....
.....
..... [1]

(d) Give **one** benefit of writing a program in a low-level language.

.....
.....
..... [1]

(e) Study the following three sections of code.

A:
```
1 0 1 0 1 1 0 1
1 1 0 0 1 1 1 0
1 0 1 1 0 1 1 1
```

B:
```
LDA X
INC X
STA Y
```

C:
```
FOR x ← 1 TO 10
READ n
ENDFOR
```

Identify, using the letters A, B or C, which of the above codes is an example of assembly code, high-level language code or machine code:

Assembly code .....
High-level language code .....
Machine code ..... [2]

10 Letters from the alphabet are represented in a computer by the following denary (base 10) values:

A = 97
G = 103
I = 105
L = 108
N = 110

The word "**A L I G N**" is stored as: 97 108 105 103 110

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(a) Convert each of the five values to binary. The first one has been done for you. [2]

Letter	Denary value							
A (97):	0	1	1	0	0	0	0	1
L(108):								
I (105):								
G (103):								
N (110):								

(b) An encryption system works by shifting the binary value for a letter one place to the left. "A" then becomes:

1	**1**	**0**	**0**	**0**	**0**	**1**	**0**

This binary value is then converted to hexadecimal; the hexadecimal value for "A" will be:

C 2

For the two letters "L" and "G", shift the binary values one place to the left and convert these values into hexadecimal: [4]

hexadecimal

L:									.....
G:									.....

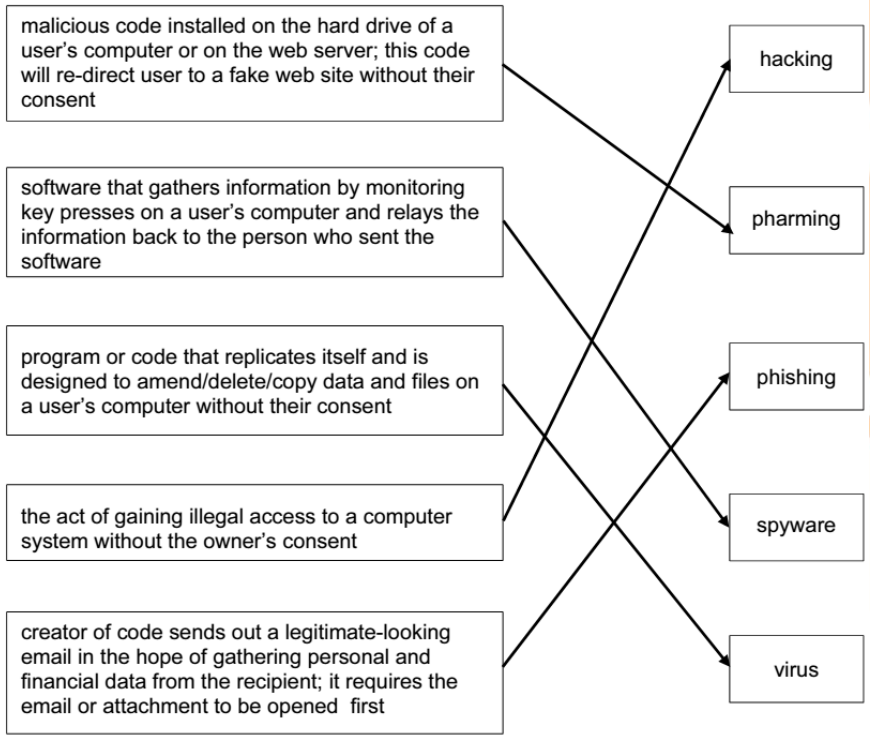
PATEL

Marking Scheme

Q 1*a(Tick (✓) to show whether the statement is true or false.

Statement	True	False
they are a form of spyware		✓
they are used only in advertising		✓
they are used to track browser use	✓	
they act in the same way as a virus		✓

(b)



2 (i) Either of the three options, resistive, capacitive or infra-red must be chosen maximum of two marks from chosen technology:
resistive
− uses multiple layers of material …
− … that transmit electric currents
− when the top layer/screen is pushed/touched into the lower/bottom layer …
− … the electric current changes and location of "touch" is found
capacitive
− current sent/flows out from all 4 corners of the screen
− when finger/stylus touches screen, the current changes
− the location of "touch" is calculated
infra-red
− an "invisible" grid on the screen (pattern of infra-red LED beams)
− sensors detect where the screen has been touched through a break in an infrared beam(s)
− the position where the screen touched is calculated [2]
(ii) 1 mark for benefit, 1 mark for drawback
Resistive
benefits:
− inexpensive/cheap to manufacture
− can use stylus/finger/gloved finger/pen
drawbacks:
− poor visibility in sunlight
− vulnerable to scratching
− wears through time
− does not allow multi-touch facility
capacitive
benefits:
− good visibility in sunlight
− (very) durable surface
− allows multi-touch facility
drawbacks:
− screen (glass) will shatter/break/crack (on impact)
− cannot use when wearing (standard) gloves
infra-red
benefits:
− good durability
− allows multi-touch facility
− can use stylus/finger/gloved finger/pen

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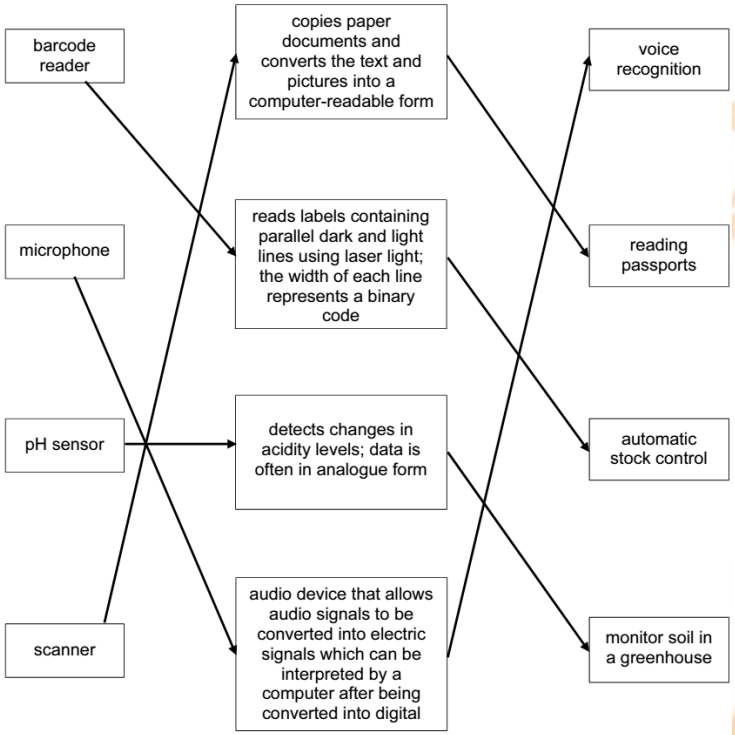
drawbacks:
− expensive to manufacture
− screen (glass) will shatter/break/crack (on impact)
− sensitive to dust/dirt [2]

3



4 (a) Any one from:
− secure sockets layer
− encrypts data being transmitted
− use of https
− use public and private keys [1]

(b) 1 mark for each number in the correct order, next to the correct stage.

Stage	Sequence number
the encrypted data is then shared securely between the web browser and the web server	6
the web browser attempts to connect to a web site which is secured by SSL	*(1)*
the web server sends the web browser a copy of its SSL certificate	3
the web browser requests the web server to identify itself	2
the web server will then send back some form of acknowledgement to allow the SSL encrypted session to begin	5
the web browser checks whether the SSL certificate is trustworthy; if it is then the web browser sends a message back to the web server	4

5 **(a)** 1 mark per correctly placed tick

Received byte	Byte transmitted correctly	Byte transmitted incorrectly
1 1 0 0 1 0 0 0		✓
0 1 1 1 1 1 0 0		✓
0 1 1 0 1 0 0 1	✓	

(b) (i) byte number: 7
column number: 6 [2]
(ii) Any two from:
− letter “A”(byte 7) transmitted as odd parity (three 1s)
− column 6 has odd parity (seven 1s)
− intersection of byte 7 and column 6 indicates incorrect bit value [2]
(c) 190 [1]
(d) Any one from:
− 2 bits interchanged (e.g. 1 → 0 and 0 → 1) that won’t change parity value
− even number of bits/digits are transposed
− If there are multiple errors in the same byte/column, that still produce the same parity bit, the error will not be detected [1]

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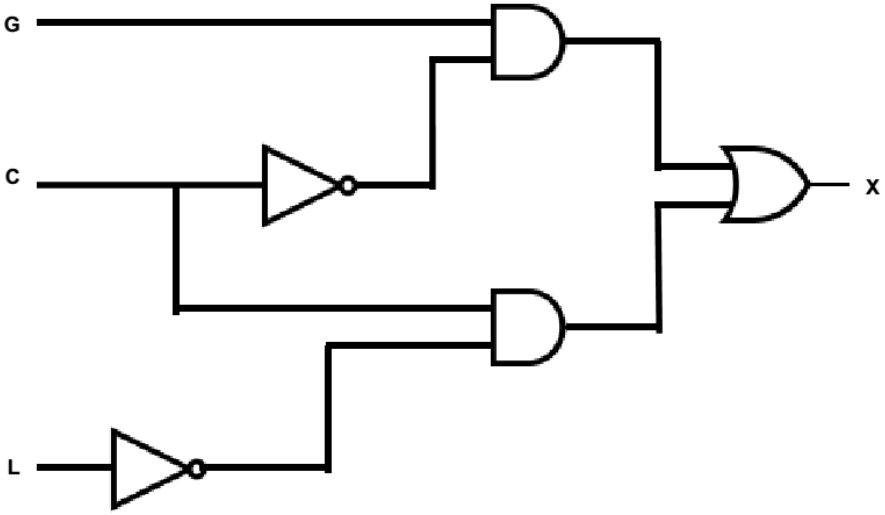
6 (a) 1 mark per correct logic gate, correctly connected



(b)

G	C	L	Workspace	X
0	0	0		0
0	0	1		0
0	1	0		1
0	1	1		0
1	0	0		1
1	0	1		1
1	1	0		1
1	1	1		0

(c) 1 mark for correctly completed truth table

A	*B*	*C*
0	*0*	**0**
0	*1*	**1**
1	*0*	**1**
1	*1*	**0**

7 (a) Maximum 5 marks in total for question part
Description of how street light is controlled: (max 4 marks)
− sensor sends signal/data to the microprocessor
− signal/data converted to digital/using ADC
− microprocessor compares value to a stored value
− if input value < stored value …
− … signal sent from microprocessor to actuator
− … and light is switched on/off
− whole process continues in an infinite loop
Avoiding frequent on/off switches: (max 2 marks)
− microprocessor continues to keep light on/off for a pre-determined period
− after pre-determined period, sensor output is again sampled [5]
b) 1 mark for correct sensor, 1 mark for its matching application
(all THREE applications must be different)

sensor	application
infra-red/motion	automatic doors
	burglar alarm systems
temperature	chemical process
	central heating/air con system
	greenhouse environment
	oven
sound/acoustic	burglar alarm systems

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	leak detection system
	disco lighting
moisture/humidity	clothes drier
	environmental control (greenhouse, air con)
pressure	burglar alarm system
	traffic light control
	chemical process
carbon dioxide/	pollution monitoring in a river
oxygen/gas	greenhouse environment (growth control)
	confined area (e.g. space craft)
	Fish tank/Aquarium
magnetic field	mobile phone
	anti-lock braking
	CD players [6]

8 1 mark per correct word
Freeware
Shareware
Free software
(Computer) Ethics
Plagiarism [5]

9 (a) 1 mark per correctly placed tick

statement	interpreter	compiler
creates an executable file that runs directly on the computer		✓
more likely to crash the computer since the machine code produced runs directly on the processor		✓
easier to debug since each line of code is analysed and checked before being executed	✓	
slow speed of execution of program loops	✓	
it is more difficult to modify the code since the executable code is now in machine code format		✓

(b) Any one from:
− code is required to be converted into machine code/binary
− code needs to be produced that can be understood by the computer [1]

(c) Any one from:
− close to English/native/human language
− easier/faster to correct errors/read/write
− works on many different machines/operating systems (portable) [1]

(d) Any one from:
− work directly on registers/CPU
− more control over what happens in computer
− can use machine specific functions [1]

(e) 1 mark per correct letter, maximum 2 marks
Assembly code: B
High-level language code: C
Machine code: A [2]

10 (a) 1 mark for two correct lines, 2 marks for four correct lines

L (108):	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**0**
I (105):	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**
G (103):	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**1**
N (110):	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**0**

(b) 1 mark for each correct binary value
1 mark for each correct hexadecimal value

									hexidecimal
L:	**1**	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**D8**
G:	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**CE**

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Winter 2015 P12

1 There are a number of security risks associated with using the Internet.

Name **three** of these risks. For each, state why it is a risk and describe how the risk can be minimised.

Security risk 1: .....

Why it is a risk: .....

.....

How to minimize the risk:.....

.....

Security risk 2: .....

Why it is a risk: .....

.....

How to minimize the risk: .....

.....

Security risk 3: .....

Why it is a risk: .....

.....

How to minimize the risk: .....

..... [9]

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2 Seven computer terms and seven descriptions are shown below.
Draw a line to link each computer term to its most appropriate description.

Interface	Reduction of file size by permanently removing some redundant information from the file
JPEG	File compression system for music which does not noticeably affect the quality of the sound
Lossless compression	Hardware component that allows the user to communicate with a computer or operating system
Lossy compression	The file is reduced in size for transmission and storage; it is then put back together again later producing a file identical to the original
MIDI	Signal sent to a processor which may cause a break in execution of the current routine, according to priorities
MP3 format	Standard adopted by the electronic music industry for controlling devices such as synthesisers and sound cards

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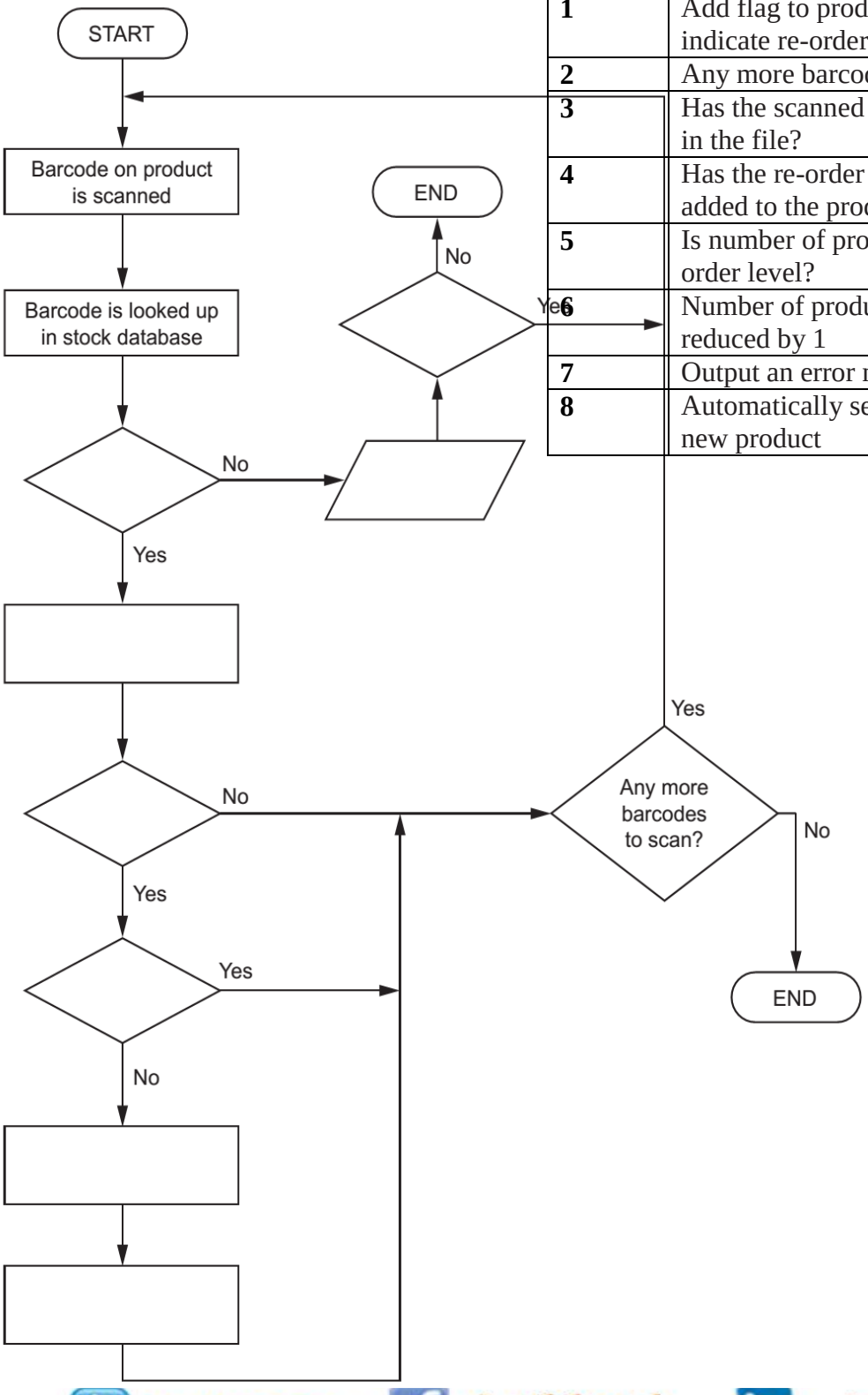
3 The flowchart on the opposite page shows what happens when the barcode on a product is scanned at the checkout in a supermarket. The barcodes are used in an automatic stock control system.

Several of the statements in the flowchart are missing.

Using **item number only** from the list below, complete the flowchart. [4]

Item number	Statement
1	Add flag to product record to indicate re-order made
2	Any more barcodes to scan?
3	Has the scanned barcode been found in the file?
4	Has the re-order flag already been added to the product record?
5	Is number of product in stock <= re-order level?
6	Number of product in stock is reduced by 1
7	Output an error message
8	Automatically send out order for new product



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4 (a) (i) Convert the following **two** hexadecimal numbers into binary:

F A 7
D 3 E

F A 7											
D 3 E											

[4]

(ii) Now perform the AND (logic) operation on each corresponding pair of binary bits in the two numbers from **part (i)**.

[2]

(iii) Convert your answer in **part (ii)** into hexadecimal.

.....
..... [2]

(b) (i) The following code shows HTML 'tag' pairs on either side of the text stating the colour that each creates.

 RED
 GREEN
 BLUE
 YELLOW
 MAGENTA
 CYAN

Yellow is a combination of red and green, magenta a combination of red and blue and cyan a combination of green and blue.

State what 6-digit hexadecimal values should replace X, Y and Z in the above code.

X .....
Y .....
Z .....[3]

(ii) Describe how other colours, such as a darker shade of blue, are created.

.....
.....
.....[2]

(c) 1A – 16 – C5 – 22 – FF – FF is an example of a MAC address.

(i) Identify what the first six and last six hexadecimal digits represent.

First six digits .....
.....
Last six digits .....
.....
..... [2]

(ii) State why MAC addresses are used.

.....
..... [1]

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5 A security system uses sensors, a camera and a microprocessor to capture images of each person entering a large shopping mall.

(a) Describe how the sensors, camera and microprocessor interact to identify certain people entering the mall.

.....
.....
.....
.....
.....
.....
.....
.....
.....[5]

(b) Each image taken requires 1 MB of storage. If the camera captures an image every 5 seconds over a 24 hour period, how much storage is required?

Give your answer in **gigabytes** and show all your working.

.....
.....
.....
.....[2]

(c) The shopping mall has over 100 cameras. At the end of each day all these cameras send their images, captured over the last 24 hours, to a central computer.

Explain why the mall uses dedicated fibre optic cable rather than transmitting the data over the local broadband network.

.....
.....
.....
.....[2]

6 (a) Explain what is meant by HTML.

.....
.....
.....
.....
.....
.....
..... [3]

(b) HTML uses both structure and presentation.

Describe what is meant by the two terms.

Structure: .....
.....
.....

Presentation: .....
.....
.....

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(c) Explain the function of a web browser.

.....
.....
.....
.....
.....
.....[3]

7 (a) Check digits are used to ensure the accuracy of input data.
A 7-digit code number has an extra digit on the right, called the check digit.
Digit position 1 2 3 4 5 6 7 8
Digit– – – – – – – –
The check digit is calculated as follows:
• each digit in the number is multiplied by its digit position
• the seven results are then added together
• this total is divided by 11
• the remainder gives the check digit (if the remainder = 10, the check digit is X)
(i) Calculate the check digit for the following code number. Show all your working.
4 2 4 1 5 0 8 …

.....
.....
.....

Check
digit .....[2]

(ii) An operator has just keyed in the following code number:
3 2 4 0 0 4 5 X
Has the operator correctly keyed in the code number?

.....
Give a reason for your answer.

.....
.....
.....
.....[3]

(b) When data are transmitted from one device to another, a parity check is often carried out on each byte of data. The parity bit is often the leftmost bit in the byte.
(i) If a system uses even parity, give the parity bit for each of the following bytes:

parity bit							
	1	**1**	**0**	**0**	**1**	**1**	**0**

parity bit							
	0	**0**	**0**	**0**	**0**	**0**	**1**

[2]

(ii) A parity check can often detect corruption of a byte.
Describe a situation in which it **cannot** detect corruption of a byte.

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.....
.....
.....[1]

8 The steps to print a document using a laser printer are shown in the table below. Put each step in the correct order. The first step has been done for you. [8]

Step	Order
As the printing drum rotates, a laser scans across it; this removes the positive charge in certain areas	
The printing drum is coated in positively-charged toner; this then sticks to the negatively-charged parts of the printing drum	
The paper goes through a fuser which melts the toner so it fixes permanently to the paper	
The printer driver ensures that the data is in a format that the laser printer can understand	**1**
A negatively-charged sheet of paper is then rolled over the printing drum	
Data is then sent to the laser printer and stored temporarily in the printer buffer	
The toner on the printing drum is now transferred to the paper to reproduce the required text and images	
The printing drum is given a positive charge	
Negatively-charged areas are then produced on the printing drum; these match exactly with the text and images to be printed	

9 A remote-controlled model car contains RAM, ROM and a solid state drive. The car receives radio signals from its remote control. It can only receive radio signals of a certain frequency. The manufacturer sets this frequency and the owner cannot change it. The owner of the model car can input their own sequence of movements from an interface underneath the car.

(a) Describe the purpose of each of the three types of memory supplied with the car.

RAM: .....
.....

ROM: .....
.....

Solid state
drive: ....
.....[3]

(b) The owner needs to be able to enter their own sequence of movements for the model car.

Name a suitable input device.

Input
device: .....
.....

Give a reason for your choice of device.

.....

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.....

.....[2]

(c) Explain why the model car uses a solid state drive rather than another type of secondary storage.

.....

.....

.....

.....[2]

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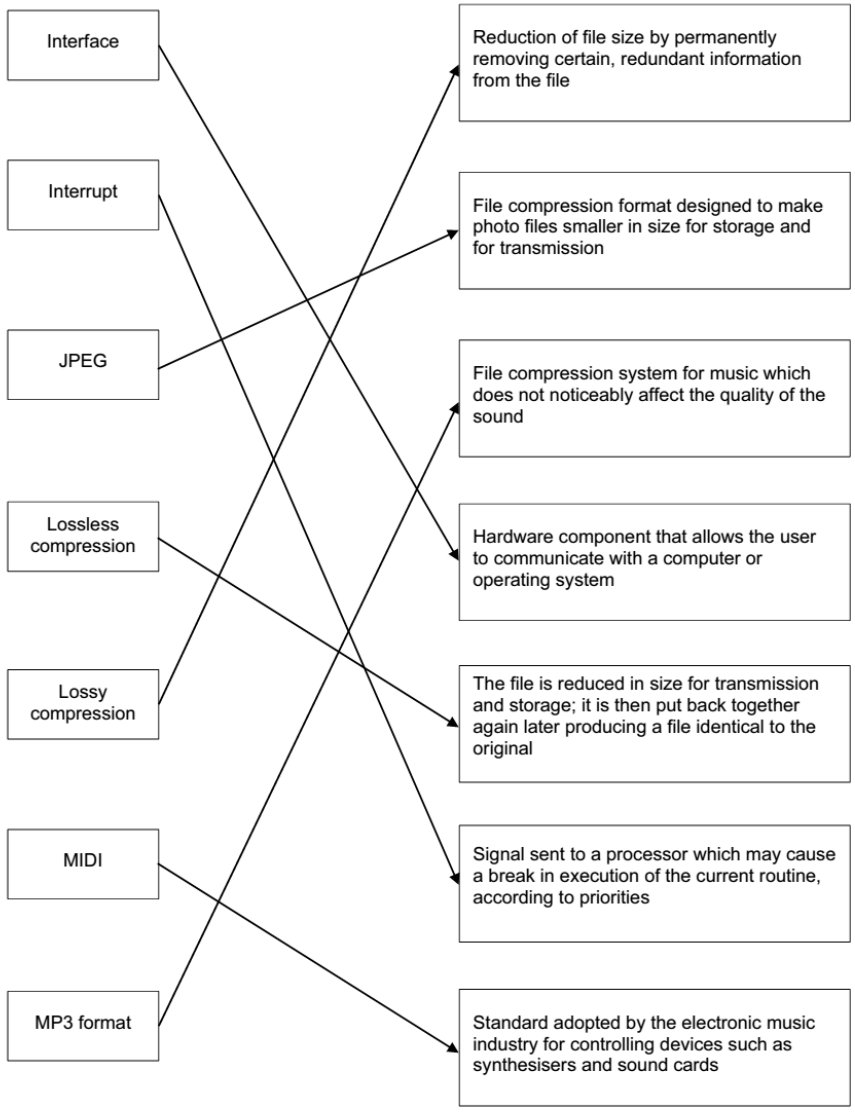
Marking Scheme Winter P12

1 1 mark for each risk + 1 mark for corresponding reason why it is a risk and 1 mark for method of minimisation

Risk: hacking
Reason: illegal/unauthorised access to data
deletion/amendment of data
Minimised: use of passwords/user ids
use of firewalls
encrypt data/encryption
Risk: virus
Reason: can corrupt/delete data
cause computer to crash/run slow
can fill up hard drive with data
Minimised: use of /run anti-virus (software)
do not download software or data from unknown sources
Risk: spyware/key logging (software)
Reason: can read key presses/files/monitors on a user's computer
Minimised: use of/run anti-spyware (software)
use data entry methods such as drop-down boxes to minimise risk
Risk: phishing
Reason: link/attachments takes user to fake/bogus website
website obtains personal/financial data
Minimised: do not open/click emails/attachments from unknown sources
some firewalls can detect fake/bogus websites
Risk: pharming
Reason: redirects user to fake/bogus website
redirection obtains personal/financial data
Minimised: only trust secure websites, e.g. look for https
check the URL matches the intended site
Risk: credit card fraud/identity theft
Reason: loss of money due to misuse of card/stealing data
Minimised: set passwords
encrypt data/encryption
Risk: cracking
Reason: illegal/unauthorised access to data
Minimised: setting strong passwords
encrypt data/encryption
There may be other valid answers given that are outside the provided mark scheme.

2



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4 (a) (i) For each hex number, 2 marks if all correct, 1 mark for 2 correct conversions

F A 7:	1	1	1	1		1	0	1	0		0	1	1	1
D 3 E:	1	1	0	1		0	0	1	1		1	1	1	0

(ii) 2 marks if all correct, 1 mark for 2 correct conversions – Follow through

1	1	0	1		0	0	1	0		0	1	1	0	

(iii) 2 marks if all correct, 1 mark for 2 correct conversions – Follow through
D 2 6 [2]

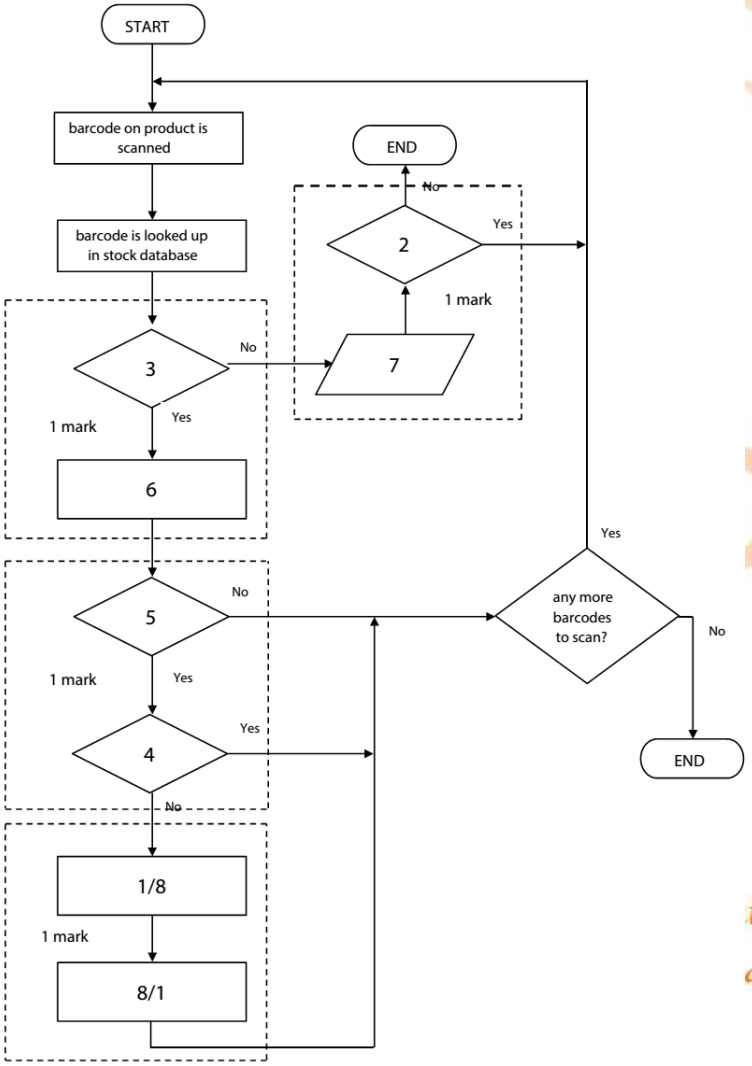
(b) (i) (X) FF FF 00
(Y) FF 00 FF
(Z) 00 FF FF [3]

(ii) – hex values between 0 to F are combined together to create a hex code
– different combinations in hex codes will create different shades/tones/colours [2]

(c) (i) First six digits: manufacturer code/manufacturer ID
Last six digits: serial number/serial ID of device/product [2]

(ii) Allows all devices to be uniquely identified [1]

3



5 (a)– naming a suitable sensor, e.g infra-red, pressure, motion sensors, send signal/data to microprocessor
– signal/data is converted to digital (using an ADC)
– microprocessor instructs/send signals to camera to capture image/video
– captured image/video data sent to microprocessor

(b) 1 mark for correct calculation, 1 mark for correct answer
– number of photos = 12 × 60 × 24 = 17280
– memory requirement = 17280/1024 = 16.9 (16.875)
– (17280/1000 = 17.28/17.3 is acceptable)
(c) Any two from:
– (data transmission) is faster
– more secure/safer (because it is a dedicated line)
– (fibre optic transmission) is more reliable

6 (a) Any three from:
– hypertext mark-up language
– used to create/develop/author webpages
– translated by a browser to display webpages
– uses (opening and closing) tags to display/format content [3]

(b) Structure:
– instructs how the layout of the content is displayed

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Presentation:
– instructs how the content will be formatted e.g. colour/style/CSS [2]
(c) Any three from:
– displays web page
– interprets/translates the HTML document
– interprets/translates embedded scripting, for example JavaScript
– provides functions, such as bookmarks and history
– identifies protocols, such as https, SSL [3]
7 (a) (i) 1 mark for correct check digit and 1 mark for showing the calculation
(4 × 1) + (2 × 2) + (4 × 3) + (1 × 4) + (5 × 5) + (0 × 6) + (8 × 7)
= 4 + 4 + 12 + 4 + 25 + 0 + 56 = 105
105/11 = 9 remainder 6
check digit is: 6 [2]
(ii) – No/incorrect check digit
– Total is 78
– 78/11 …
– … gives 7 remainder 1
– check digit should be 1 [3]
(b) (i) 1 mark for each correct parity bit

parity bit							
0	1	1	0	0	1	1	0

parity bit							
1	0	0	0	0	0	0	1

(ii) Any one from:
– an even number of digits are changed
– a transposition error(s) has occurred [1]
8 1 mark for each step in correct order. (NOTE: Marks can be awarded for a correct sequence.)

Steps in the printing process	Step order
As the printing drum rotates, a laser scans across it; this removes the positive charge in certain areas	**4**
The printing drum is coated in positively-charged toner; this then sticks to the negatively-charged parts of the printing drum	**6**
The paper goes through a fuser which melts the toner so it fixes permanently to the paper	**9**
The printer driver ensures that the data is in a format that the laser printer can understand	***(1)***
A negatively-charged sheet of paper is then rolled over the printing drum	**7**
Data is then sent to the laser printer and stored temporarily in the printer buffer	**2**
The toner on the printing drum is now transferred to the paper to reproduce the required text and images	**8**
The printing drum is given a positive charge	**3**
Negatively-charged areas are then produced on the printing drum; these match exactly with the text and images to be printed	**5**

9(a) RAM: contains instructions/program/data currently in use
ROM: any one from:
– contains the start-up/bootstrap program
– contains/stores the setting for frequency (can't be changed)
Solid state drive: – stores the instructions/program/data (to operate the car)
(b) 1 mark for device and 1 mark for corresponding reason
Device:– touch screen
– key pad (NOT keyboard)
Reason: – easy to use interface
– limited number of options
– small space/space is limited
– other devices such as mouse, keyboard, tracker ball, … not suitable
(c) Any two from:
– A solid state drive has no moving parts
– A solid state drive has faster random access
– A solid state drive has a quick start up/shut down time (reduced latency)
– A solid state drive is very small
– A solid state drive is very light
– A solid state drive consumes very little power
– A solid state drive does not generate a lot of heat (therefore safer in this application)

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Winter 2015 P13

1 (a) Name an application which makes use of the following sensors. A different application should be used in each case.

Temperature .....
.....

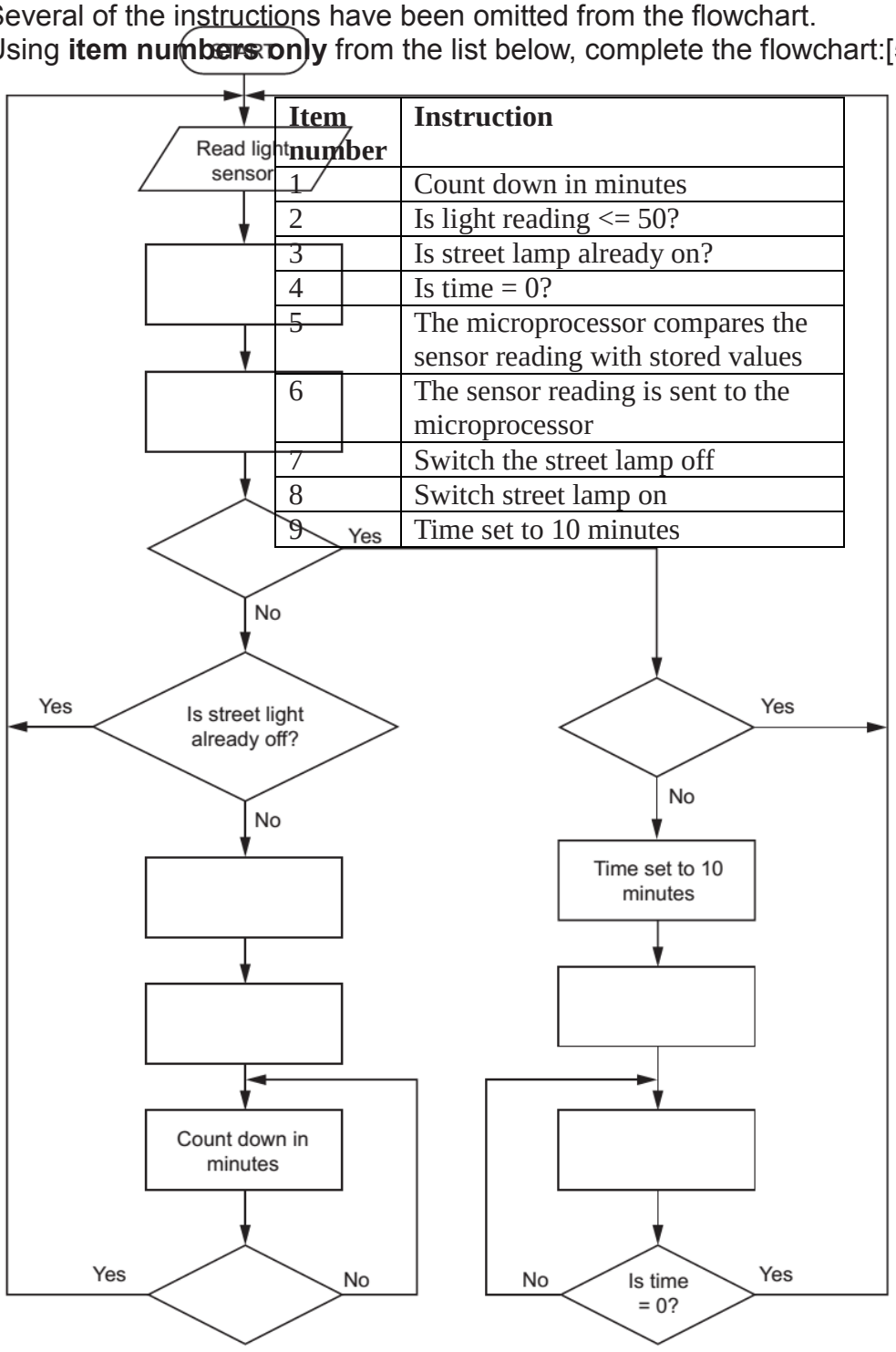
Magnetic field .....
.....

Motion .....
..... [3]

(b) The flowchart on the opposite page shows how a light sensor and microprocessor are used to switch a street lamp on or off. When the sensor reading is <= 50 light units, the lamp is turned on automatically.

Several of the instructions have been omitted from the flowchart.

Using **item numbers only** from the list below, complete the flowchart:[5]



Item number	Instruction
1	Count down in minutes
2	Is light reading <= 50?
3	Is street lamp already on?
4	Is time = 0?
5	The microprocessor compares the sensor reading with stored values
6	The sensor reading is sent to the microprocessor
7	Switch the street lamp off
8	Switch street lamp on
9	Time set to 10 minutes

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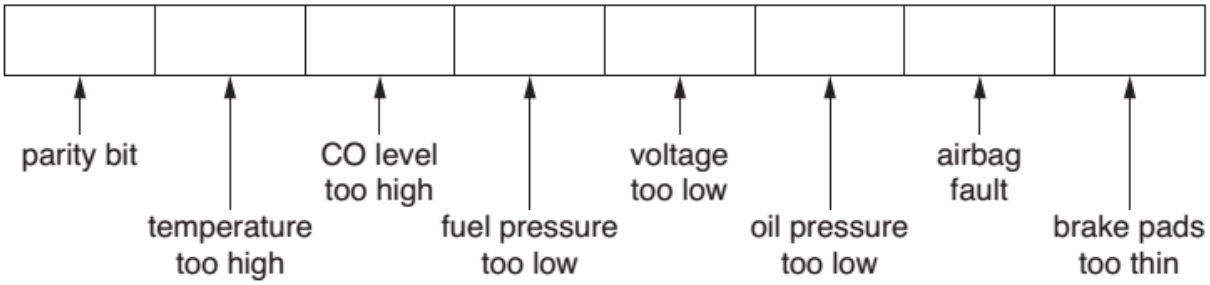
2 Sensors and a microprocessor monitor a car exhaust for high temperature and high carbon monoxide (CO) levels.

(a) Describe how the sensors and microprocessor are used to monitor the temperature and CO levels and warn the driver if either is out of range.

.....
.....
.....
.....
.....
.....
.....
.....[5]

(b) The information from seven sensors is sent to an engine management system in the car. The status of each sensor is stored in an 8-bit register; a value of 1 indicates a fault condition



For example, a register showing **0 1 0 1 1 0 0 0** indicates:

- temperature too high
- fuel pressure too low
- voltage too low

(i) Identify the fault condition(s) that the following register indicates:

0	0	1	0	0	1	0	1

.....
.....
.....[2]

(ii) The system uses **odd** parity.

Write the correct parity bit in each register.

	1	1	1	0	0	1	0

	0	0	0	1	1	1	0

[2]

(iii) A car has a faulty airbag and the CO level is too high.

Write what should be contained in the 8-bit register.

[2]

(iv) Give the hexadecimal value of the binary number shown in **part (iii)**.

.....
.....[1]

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3 A section of computer memory is shown below:

Address	Content
1000 0000	0110 1110
1000 0001	0101 0001
1000 0010	1000 1101
1000 0011	1000 1100
1000 1100	
1000 1101	
1000 1110	
1000 1111	

(a) (i) The contents of memory location 1000 0001 are to be read.
Show the contents of the Memory Address Register (MAR) and the Memory Data Register (MDR) during this read operation:

MAR | | | | | | | | |

MDR | | | | | | | | | [2]

(ii) The value 0111 1001 is to be written into memory location 1000 1110.
Show the contents of the MAR and MDR during this write operation:

MAR | | | | | | | | |

MDR | | | | | | | | | [2]

(iii) Show any changes to the computer memory following the read and write operations in **part (a)(i)** and **part (a)(ii)**. [1]

Address	Content
1000 0000	0110 1110
1000 0001	0101 0001
1000 0010	1000 1101
1000 0011	1000 1100
1000 1100	
1000 1101	
1000 1110	
1000 1111	

(b) Name **three** other registers used in computers.

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1 .....
2 .....
3 ..... [3]

(c) The control unit is part of a computer system.
What is the function of the control unit?

.....
.....
.....
.....
.....
..... [3]

4 (a) Computer ethics involves a number of different topics.
(i) A student made the following statement on an examination paper:
"It allows a user to have the freedom to run, copy, change and adapt the software and then pass it on to a colleague, friend or family member."
Identify which computer term the student was describing.

..... [1]

(ii) Explain what is meant by computer ethics.

.....
.....
.....
.....
.....
..... [3]

(b) The four statements below refer to firewalls and proxy servers. Study each statement.
Tick (9) the appropriate column(s) to indicate whether the statement refers to a firewall and/or a proxy server. [4]

Statement	**Firewall**	**Proxy server**
Speeds up access of information from a web server by using a cache		
Filters all Internet traffic coming into and out from a user's computer, intranet or private network		
Helps to prevent malware, including viruses, from entering a user's computer		
Keeps a list of undesirable websites and IP addresses		

(c) Explain **three** ways of preventing **accidental** loss or corruption of data.

1 .....
.....
.....
.....
2 .....
.....
.....
.....
3 .....
.....
.....
..... [6]

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5 A security system records video footage. One minute of video requires 180 MB of storage. The recording system can store several hours of video footage.

(a) Name and describe a suitable storage device for this recording system.

.....
.....
.....
..... [2]

(b) Calculate how much storage would be needed for 2 hours of video footage.
Show your working and give the answer in Gigabytes (GB).

.....
.....
.....
..... [2]

6 Passengers fly into an airport from other countries. The airport has a security system that uses:

- computers
- scanners
- digital cameras

To gain entry to the country, each passenger must have a passport or identification (ID) card. This must contain a recent photograph and other personal data. The passenger must:

- place their passport or ID card on a scanner that reads machine-readable characters and scans the photograph
- look towards a camera that takes an image of the passenger's face

Describe how a computer checks whether the image just taken by the camera matches the scanned photograph.

.....
.....
.....
.....
.....[2]

7 Name a suitable output device for each of the following applications. A different device should be used for each application.

Application	**Suitable output device**
Production of one-off photographs of very good quality	
High volume colour printing of advertising flyers	
Production of an object, which is built up layer by layer; used in CAD applications	
Converting electrical signals into sound	
Showing enlarged computer output on a wall or large screen	

8 Four input devices are shown in the table below.
Give an application which makes use of each device and state a reason why the device is appropriate for that application. Your application must be different in each case.

Input device	**Application and reason**
Light sensor	Application ..... Reason ....
Keyboard	Application ..... Reason .....

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	....
Barcode reader	Application ..... Reason ....
Touch screen	Application ..... Reason ....

9 MP3 file compression reduces the size of a music file by 90%.
(a) A music track is 80 MB in size.
Calculate the file size after compression.
.....
.....
How many MP3 files of the size calculated above could be stored on an 800 MB CD?
.....
.....
[2]
(b) (i) Explain how MP3 files retain most of the original music quality.
.....
.....
.....
.....
..... [2]
(ii) State the type of file compression used in MP3 files.
..... [1]
(iii) Name another file compression format.
..... [1]
10 Choose **five** correct terms from the following list to complete the spaces in the sentences below:
• cypher text
• encryption algorithm
• encryption key
• firewall
• plain text
• proxy server
• symmetric encryption
..... is a security system.
It uses the same ..... to encrypt and decrypt a message. Before encryption, the message is called ..... .
The ..... processes the original message. The output is known as ..... . [5]

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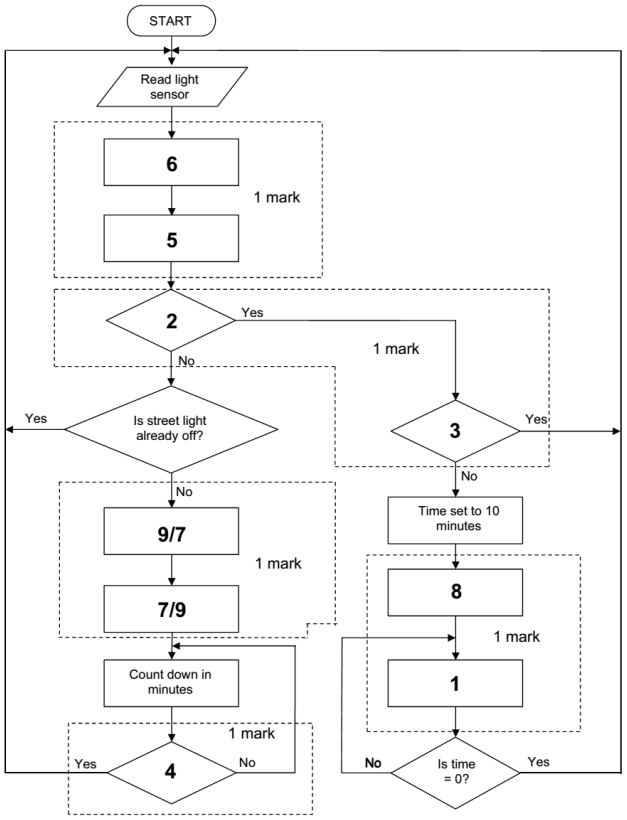
Marking Scheme p13 Winter 2015

Q 1 a) Temperature: – central heating/ air con system
– Greenhouse environment
– A chemical reaction/ process
Magnetic field: – anti-lock brakes on a car
– Detection of motor vehicles (e.g. at traffic lights)
– reading magnetic ink characters on cheques
– Geophysical surveys
Motion: – automatic doors
– Burglar alarm

(b)



Q 2a) (a) Any five from:
– sensors send signals/ data to microprocessor
– signal/ data converted to digital (by an ADC)
– microprocessor compares temperature/ carbon monoxide level/value with stored
level/ value
– if CO level > stored value, microprocessor sends signal…
– if temperature > stored value, microprocessor sends signal…
– …to light warning bulb on dashboard/ sounds alarm
(b) (i) 2 marks for all correct conditions, 1 mark for 2 correct conditions
CO (carbon monoxide) level too high
oil pressure too low
brake pads too thin [2]
(ii) 1 mark for each correct parity bit in position 1
1 1 1 1 0 0 1 0
0 0 0 0 1 1 1 0 [2]
(iii) 1 mark for correct parity bit + 1 mark for remainder of binary value
1 0 1 0 0 0 1 0 [2]
(iv) A 2 (allow follow through from part (iii)) [1]
3 (a) (i)
1 0 0 0 0 0 0 1
0 1 0 1 0 0 0 1 [2]
(ii)
1 0 0 0 1 1 1 0
0 1 1 1 1 0 0 1 [2]
(iii)

Address	Contents
1000 0000	0110 1110
1000 0001	0101 0001
1000 0010	1000 1101
1000 0011	1000 1100
1000 1100	
1000 1101	
1000 1110	0111 1001
1000 1111	[1]

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(b) – CIR (Current Instruction Register)
– PC (Program Counter)
– Acc (Accumulator) [3]
(c) – Controls operation of memory, processor and input/output
– Instructions are interpreted
– Sends signals to other components telling them "what to do" [3]
4 (a) (i) Free software/ open source software [1]
(ii) Any three from:
– Set of principles/ laws that regulate the use of computers
– Covers intellectual property rights (e.g. copying of software)
– Privacy issues (e.g. accessing personal information)
– Impact of computers on society (relevant examples can be credited) [3]

(b) 1 mark for each CORRECT row

Statement	Firewall	Proxy server
Speeds up access of information from a web server by using a cache		✓
Filters all Internet traffic coming into and out from a user's computer, intranet or private network	✓	✓
Helps to prevent malware, including viruses, from entering a user's computer	✓	
Keeps a list of undesirable websites and IP addresses	✓	✓

(c) one mark for method + one mark for linked reason (maximum 6 marks)
– back up files…
– …on a regular basis/ to another device/ to the cloud
– set data to read only…
– …to prevent accidental editing
– save data on a regular basis…
– …to prevent loss/ corruption of data in unexpected shutdown/failure
– use correct shut down/ start up procedures…
– …to prevent damage to components/ stored files
– use correct procedures before disconnecting portable storage device…
– …to prevent damage to device/ data corruption
– keep storage devices in a safe place…
– …away from fire hazards [6]
5 (a) – Memory card/ SSD / HDD/ magnetic tape
– Suitable description of device given [2]
(b) 2 hours = 120 minutes
120 × 180 = 21600
21600/ 1024 (or 21600/ 1000)
= 21.1GB (or 21.6GB)
(1 mark for correct answer and 1 mark for correct calculation) [2]
6 Any two from:
– facial recognition software/ biometric software used to scan face
– face image converted to digital format/ data by the camera
– digital image formed from scanned photo/ biometric data stored in passport
– key features of the face are checked/ compared
7

Application	Suitable output device
Production of one-off photographs of very good quality	Inkjet Printer
High volume colour printing of advertising flyers	Laser Printer
Production of an object, which is built up layer by layer; used in CAD applications	3D Printer
Converting electrical signals into sound	Speaker
Showing enlarged computer output on a wall or large screen	Projector

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Winter 2015 0478 P11

1 (a) Four hardware items are shown in the table below.
For each hardware item:
• name a suitable application
• state how it is used in the application
Give a different application in each case. [8]

Hardware item	**Application**	**How the hardware item is used**
Microphone	....	....
Barcode reader	....	....
Touch screen	....	....
Infrared sensor	....	....

(b) Describe **two** differences between Blu-ray discs and DVDs.
1: .....
2: .....
.....[2]
(c) Describe **two** differences between DVD-R and DVD-RAM.
1: .....
.....
2: .....
.....[2]
2 (a) Convert the hexadecimal number **B5** into binary:
.....
Convert the binary number **1 1 1 1 0 1 1 0** into hexadecimal:
.....[2]
(b) Give **two** examples where hexadecimal numbers are used in computer science.
1: .....
2: .....
.....[2]
(c) State **two** benefits of using hexadecimal numbers in computer science.
1: .....
.....
2: .....
.....[2]

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3 (a) Three statements about cookies are shown below.
Study each statement. Tick to show whether the statement is true or false. [3]

Statement	True	False
Cookies can destroy or modify data in a computer without the user's knowledge		
Cookies generate website pop-ups		
Cookies allow a website to detect whether a viewer has viewed specific web pages		

(b) Two features of Von Neumann architecture are the use of registers and the use of buses.
Give the names of **two** registers and **two** buses.
Registers
1: .....
.....
2: .....
.....

Buses
1 .....
.....
2: .....
.....[4]

4 Six computer terms and six descriptions are shown below.
Draw a line to link each term to its appropriate description.[5]

Browser	Signal sent to a processor which may cause a break in execution of the current routine, according to priorities
HTML	Company that provides individual's access to the Internet and other services such as webhosting and emails
Internet service provider	Software application used to locate, retrieve and display content on the World Wide Web e.g. web pages, videos and other files
Interrupt	Hardware identification number that uniquely identifies each device on a network; it is manufactured into every network card and cannot be altered
IP address	Authoring language used to create documents on the World Wide Web; uses tags and attributes
MAC address	Location of a given computer/device on a network; can be a static or dynamic value

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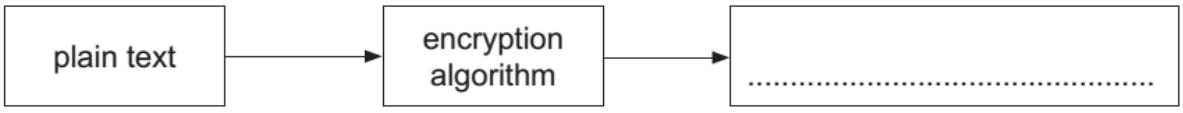
5 (a) Inkjet printers and laser printers are two common types of printer.
Describe the features and principles of operation of each type of printer.
(i) Inkjet printer
.....
.....
.....
.....
..... [4]
(ii) Laser printer
.....
.....
.....
.....
..... [4]

(b) Another type of printer is the 3D printer.
Describe 3D printing.
.....
.....
.....
.....
..... [3]
6 (a) State what is meant by encryption.
.....
..... [1]
(b) State what is meant by symmetric encryption.
.....
..... [1]
(c) Complete the diagram: [1]



7 (a) Describe what is meant by lossy and lossless compression when applied to files.
Lossy: .....
.....
.....
Lossless: .....
.....
.....[2]
(b) Name and describe **one** type of file that uses lossy compression.
Name: .....
Description: .....
.....
.....[2]
(c) A company advertises its backup memory device as having 500 GB of storage.
A customer wishes to know how many 8 MB files could be stored on the device.
The company claimed that up to 62 500 files (assuming each file is 8 MB) could be stored.
The customer calculated that 64 000 files could be stored.
Explain the difference between these two storage values. Show any calculations you use

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in your explanation.
.....
.....
.....
.....
..... [3]

8 State **three** features of a typical operating system.
1: .....
.....
2: .....
.....
3: .....
.....[3]

9 (a) Nicolae made the following statement:
"data input is validated by typing it in twice"
State why this statement is incorrect.
.....
..... [1]
(b) Nicolae needs to send 30 photos to a friend and he chooses to send all 30 together as a single email attachment. Each photo is 1.8 MB in size, but the maximum possible attachment size is only 20 MB.
State how Nicolae can solve this problem.
.....
..... [1]
10 Characters can be represented in a computer by a numerical code.
The following list shows 16 characters with their numerical codes in denary:

a = 97	d = 100	h = 104	m = 109	t = 116
b = 98	e = 101	i = 105	o = 111	u = 117
c = 99	g = 103	k = 107	r = 114	w = 119

. = 46 (code for the full stop)

Web addresses can be written using hexadecimal rather than denary. Hexadecimal codes are preceded by a % sign. For example, the word "**c a g e**" is written as:

either	99	97	103	101	(in denary)
or	%63	%61	%67	%65	(in hexadecimal)

(a) Complete the conversion of the following web address into hexadecimal: [3]

w	w	w	.	c	i	e	.	o	r	g	.	u	K
%77	%77	%77											

b) Complete the web address from the given hexadecimal codes: [3]

%77	%77	%77	%2E	%72	%6F	%63	%6B	%69	%63	%74	%2E	%63	%6F	%6D
w	w	w												

11 A passenger logs onto an airline website and types in the reference number for their flight. Once the passenger accesses their account they can choose their seat and also print out a boarding pass which contains a unique barcode. This barcode is scanned at the airport check-in desk.

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Name **one** input and **one** output device found at the check-in desk and give a reason for your choice.
Input device: .....
Reason: .....
.....
Output device: .....
Reason: .....
.....[4]

12 Parity checks are used to check for errors during data transmission. A system uses **odd** parity.

(a) Complete the following two bytes of data so that they both have **odd** parity:

	1	1	1	1	0	0	0

	0	0	0	0	1	1	1

(b) Name and describe another method which can be used to check whether data has been correctly transmitted.
Name of method: .....
Description: .....
.....
.....[2]

13 Identify which **five** computer terms are being described below.

(a) A system designed to prevent unauthorised access to or from a private network or intranet; it examines all data traffic to and from the network and filters out anything that does not meet certain criteria.
..... [1]

(b) Software that can be used on a trial basis before buying the full version; it often does not include all the features of the full version or has a time limit before it stops working.
.....[1]

(c) A protocol for transmitting private documents via the Internet; it uses two keys to encrypt the data – a public key and a private key.
.....[1]

(d) A standard adopted by the electronic music industry for controlling devices that produce music, such as synthesisers and sound cards.
..... [1]

(e) A device that allows audio signals to be converted into electrical signals which can be interpreted by a computer after being converted into digital signals.
.....[1]

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Marking Scheme

Q1)a

Hardware item	***Application***	***How the hardware item is used***
Barcode reader	*Supermarket checkout* *Library system* *Airport checkouts*	*– read barcodes to find prices, description* *– allows automatic stock control* *– can track books on loan* *– can link books to borrowers using barcoded cards* *– barcodes on luggage to track whereabouts*
Microphone	*Voice recognition system* *Multimedia presentations* *Video conferencing/VoIP*	*– allows computer to recognise spoken words and use them as input to, e.g., a word processor* *– allows voice-overs on presentations* *– allows users to speak to each other*
Touch screen	*Mobile telephone/tablet* *Ticket/information kiosk*	*– allows user to select apps/icons* *– easy method to input data* *– limits the options available for ease of use*
Infrared sensor	*Burglar/intruder detection system* *Automatic doors* *Counting, e.g. people/cars*	*– detects presence of a person by breaking beam/change of temperature* *– breaking i/r beam allows detection of person approaching door* *– every time beam is broken it can automatically send data and allow automatic counting*

(b) Any two from:

– Blu-ray discs use blue/violet lasers rather than red lasers as used by DVDs
– storage capacity of Blu-ray discs is much higher than standard DVDs
– Blu-ray discs use one polycarbonate layer; DVDs use two layers
– Blu-ray discs have a built-in secure encryption system [2]
(c) Any two from:
– DVD has one spiral track; DVD-RAM has several concentric tracks
– DVD-RAM can be written to and read from at the same time; DVD-R only allows the read operation to occur
– DVD-R only allows data to be read (can't write to it) whereas DVD-RAM allows reading and writing operation [2]
2 (a) 1 0 1 1 0 1 0 1
F 6 [2]
(b) Any two from:
– HTML
– MAC address
– used in assembly language/machine code
– debugging (displays bytes in hex when using memory dumps) [2]
(c) – Can represent 16 bit words as only 4 hexadecimal digits
– It is easy to convert hex digits back to binary if necessary [2]

3 (a)

Statement	True	False
Cookies can destroy or modify data in a computer without the user's knowledge		✓
Cookies generate website pop-ups		✓
Cookies allow a website to detect whether a viewer has viewed specific web pages	✓	

(b) Registers
Any two from:
– PC (Program Counter) *– MAR (Memory Address Register)*
– MDR (Memory Data Register) *– CIR or IR ((Current) Instruction Register)*
– ACC (Accumulator)
Buses
Any two from:
– control – data – address

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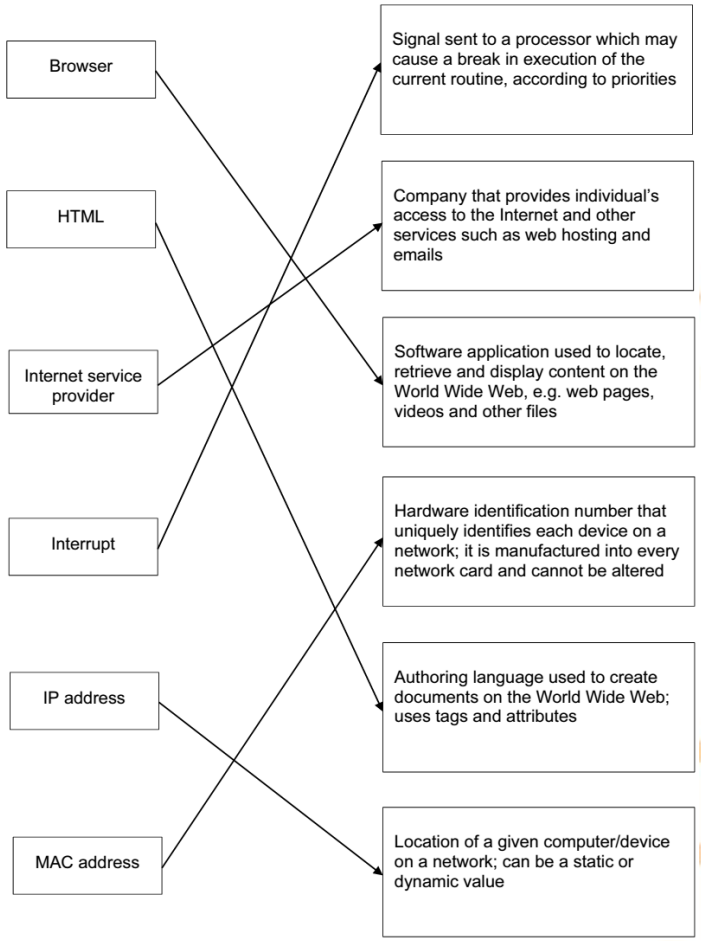
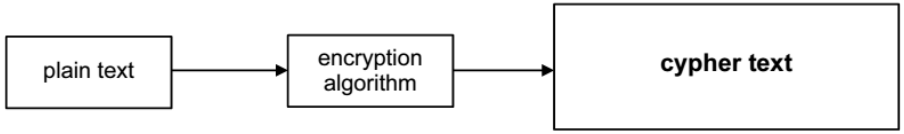
Q4)



5 (a) (i) Inkjet printer
Any four from:
– uses cartridges/liquid ink
– makes use of thermal bubble/piezoelectric technology
– sprays ink in droplets on the paper
– uses a moving print head
– suitable for low volume (high quality) output, e.g. a photo *[4]*
(ii) Laser printer
Any four from:
– uses powdered ink/toner cartridges
– uses a (charged) printing drum
– makes use of static electricity charges
– uses a fuser to fix/melt ink onto the paper
– uses a discharge lamp to remove static charge from the drum
– useful for high volume (high quality) output, e.g. leaflets *[4]*
(b) Any three from:
– produces solid, 3D objects/prototypes
– used in CAD/CAM
– makes use of tomography/slices of an object
– solid built up in thin layers
– uses resin, powdered metal, paper, plastic… *[3]*
6 (a) Any one from:
– jumbling up/scrambling characters so that message makes no sense
– requires an encryption key to encrypt data
– need decryption key to decipher encrypted message *[1]*
(b) Uses the same key to encrypt and decrypt message *[1]*
(c) 1 mark for correct name in box



7 (a) Lossy
– when decompressed, some detail is lost and file is not exactly like the original (but difference is usually not noticeable)
Lossless
– when decompressed the original file is restored with no loss of data
[2]
(b) 1 mark for type of file + 1 mark for description e.g:
– JPG
– Used to store images/pictures
– MP3

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– Used to store audio/sound files [2]
(c) Any three from:
– company calculation is based on 1 GByte = 1000 MByte
– so (500 × 1000)/8 = 62 500 files
– customer calculation based on 1 GByte = 1024 MByte
– so (500 × 1024)/8 = 64000 files
– giving the difference of 1500 files [3]
8 Any three from:
– provides a user interface
– input/output control/handling
– security
– (handling) interrupts
– spooling
– memory management
– processor management
– utilities (e.g. copy, save, delete, rename, etc.)
– maintain user accounts
– load/run software
– error reporting/handling
– multiprogramming
– batch processing/JCL
– multitasking
9 (a) Any one from:
– verification is being described
– validation is when data follows a set of rules, e.g. length/range/type check
[1]
(b) Any one from:
– send as JPEG files
– carry out a file compression first
[1]

10 (a)

w	w	w	.	c	i	e	.	o	r	g	.	u	k
%77	%77	%77	%2E	%63	%69	%65	%2E	%6F	%72	%67	%2E	%75	%6B

(b)

%77	%77	%77	%2E	%72	%6F	%63	%6B	%69	%63	%74	%2E	%63	%6F	%6D
W	W	W	.	r	o	c	k	i	c	t	.	c	o	m

11 1 mark for each input device + 1 mark for correct MATCHING reason for each device
Input Devices
– Barcode scanner
– … to scan the barcode on boarding pass/mobile phone screen
– keyboard
– … to key in data in case barcode fails to scan
– (electronic) scales
– … weigh luggage at check-in
1 mark for each output device + 1 mark for correct MATCHING reason for each device
Output Devices
– beeper/speaker
– … confirm barcode read/indicate error if barcode not read
– (LCD) screen
– … select options (e.g. airline) at check-in
– printer
– … produce bag labels

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12 (a)

1	1	1	1	1	0	0	0

0	0	0	0	0	1	1	1

(b) 1 mark for error detection method and 1 mark for description
– Check sum
– … sum of bits is transmitted and checked against the sum of the received bits
– Check digit
– … a digit that is calculated (e.g. using modulo-11) and transmitted with the data
– ARQ
– … when an error is detected in a packet of data a request is automatically sent for the data to be resent
13 (a) Firewall [1]
(b) Shareware [1]
(c) SSL (secure socket layer) (accept HTTPS and TLS) [1]
(d) MIDI [1]
(e) Microphone [1]

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